



City of Springfield, Missouri

Design Standards  
for  
Public Improvements

Adopted 5-10-02

Marc Thornsberry  
Director of Public Works

## TABLE OF CONTENTS

### CHAPTER I DEFINITIONS AND POLICIES

- A. DEFINITION OF TERMS, PHRASES, AND WORDS.....Page I-1
- B. PUBLIC WORKS POLICIES.....Page I-6

### CHAPTER II PLAN PREPARATION

- A. DRAWING STANDARDS.....Page II-1
- B. SUBMISSION OF ENGINEERING PLANS.....Page II-3
- C. PRE-CONSTRUCTION REQUIREMENTS.....Page II-3

### CHAPTER III SURVEY REQUIREMENTS

- A. SURVEYING WORK.....Page III-1

### CHAPTER IV EARTHWORK

- A. EMBANKMENT CONSTRUCTION.....Page IV-1
- B. SUBGRADE COMPACTION.....Page IV-1

### CHAPTER V SANITARY SEWERS

- A. GENERAL.....Page V-1
- B. SANITARY SEWER DESIGN.....Page V-1
- C. DRAWINGS AND DOCUMENTS TO BE SUBMITTED.....Page V-7
- D. LIFT STATIONS.....Page V-8
- E. FORCE MAINS.....Page V-20

### CHAPTER VI STORM SEWER AND DRAINAGE DESIGN

- A. MINIMUM REQUIREMENTS FOR STORM SEWER  
AND DRAINAGE DESIGN.....Page VI-1
- B. REQUIREMENTS RELATING TO IMPROVEMENTS.....Page VI-2
- C. RUNOFF CALCULATIONS.....Page VI-4

D.	SIZING OF STORM SEWERS AND DRAINAGE STRUCTURES.....	Page VI-6
----	---	-----------

## CHAPTER VII STORM WATER DETENTION REQUIREMENTS FOR PUBLIC AND PRIVATE IMPROVEMENTS

A.	GENERAL.....	Page VII-1
B.	DETENTION REQUIREMENT.....	Page VII-1
C.	DETERMINATION OF PARAMETER VALUES.....	Page VII-2
D.	DETERMINATION OF WATERSHED AREA AND CURVE NUMBER.....	Page VII-3
E.	DETERMINATION OF RUNOFF.....	Page VII-3
F.	DETERMINATION OF TIME OF CONCENTRATION AND TRAVEL TIME.....	Page VII-4
G.	DETERMINATION OF PEAK DISCHARGE.....	Page VII-5
H.	DETERMINATION OF STORAGE VOLUME FOR DETENTION BASINS.....	Page VII-6
I.	TYPES OF OUTLET STRUCTURES PERMITTED.....	Page VII-6
J.	DOWNSTREAM OUTLET CONTROL.....	Page VII-7
K.	STORMWATER DETENTION PAYMENT IN LIEU OF CONSTRUCTION.....	Page VII-8
L.	STORMWATER AND DETENTION EASEMENTS.....	Page VII-9
M.	TEMPORARY DETENTION.....	Page VII-9
N.	OFF-SITE AND REGIONAL DETENTION CONCEPTS.....	Page VII-10
O.	MAINTENANCE.....	Page VII-10

## CHAPTER VIII STREETS, ALLEYS, CUL-DE-SACS, AND INTERSECTIONS

A.	STREETS.....	Page VIII-1
----	--------------	-------------

## CHAPTER IX - NOT USED

CHAPTER X SIDEWALKS, CURB AND GUTTER, AND DRIVEWAYS

A.	SIDEWALKS.....	Page X-1
B.	CURB AND GUTTER.....	Page X-4
C.	DRIVEWAYS.....	Page X-6

CHAPTER XI MISCELLANEOUS

A.	TRAFFIC SIGNALS.....	Page XI-1
B.	PARKING STALL REQUIREMENTS.....	Page XI-1
C.	RIPRAP.....	Page XI-1
D.	STREET TREE PLANTING - PUBLIC IMPROVEMENTS.....	Page XI-1

## CHAPTER I - DEFINITIONS AND POLICIES

### A. DEFINITION OF TERMS, PHRASES, AND WORDS

1. Alley. A minor way which is used primarily for vehicular service access to the back or the side of properties otherwise abutting a street.
2. Arterial Street (Primary). A street or highway primarily intended to provide for high volume, moderate speed, and extended trip length traffic movement between major activity centers, with access to abutting property subordinate to major traffic movement.
3. Arterial Street (Secondary). A street which interconnects with and augments the major arterial system. The secondary arterial is primarily intended to provide for moderate volume, moderate speed, and short to moderate trip length while providing partially controlled access to abutting property
4. Bench Mark. A permanent object of known elevation and location that is in an area where disturbance is unlikely.
5. Block. A piece of parcel of land entirely surrounded by public highways, streets, streams, railroad right-of-way, parks, or a combination thereof.
6. Bridge. A structure having a clear span greater than twenty (20) feet or a multiple span structure where the total length of the span is in excess of twenty (20) feet.
7. City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction. The official General Conditions and Technical Specifications used on public city improvements within the City of Springfield, Missouri. This document contains data for public improvements from the advertising stage of a project through the actual construction and acceptance of the project.
8. Collector Street. A street which collects and distributes traffic to and from local and arterial street systems. The collector is primarily intended to

provide for low to moderate volume, low speed, and short length trips while providing access to abutting property.

9. Consultant. An individual, firm, association, partnership, corporation, or other legal entity registered in the State of Missouri and engaged in the practice of engineering or architecture.
10. Corner. A point of intersection of lines of two street curb faces extended into street intersection.
11. Crosswalk. A right-of-way, dedicated to or set aside for public use, which cuts across a block or street to facilitate pedestrian access to adjacent streets and properties.
12. Cul-de-sac or Dead-end Street. A minor street with only one outlet.
13. Culvert. A structure not classified as a bridge, which provides a conduit for drainage.
14. Curb Return. The portion of curb at the beginning of a driveway approach, which serves as a transition from the height of the curb to the level of the approach.
15. Driveway. An area intended for the operation of automobiles and other vehicles from the street right-of-way line to a garage, parking area, building entrance, structure, or approved use located on the property. Any dimensions relating to the width of a driveway or driveway surface shall be measured at the right-of-way line.
16. Driveway Approach. An area intended for the operation of automobiles and other vehicles giving access between a roadway and abutting property. The driveway approach includes the sum of the curb returns on each side of the driving surface, plus the driving surface.
17. Easement. A grant by the property owner to the public, a corporation, or persons of the use of land for specific purposes.
18. Expressway. A street or highway with limited and partially controlled points of access at arterial

system intersections. The expressway is primarily intended to provide for high volume, moderate to high speed extended intra-city traffic between major activity centers with minimal impairment to movement.

19. Freeway. A divided highway with fully controlled access limited to grade-separated interchanges constructed at major thoroughfares. A freeway is primarily intended to provide for high-volume, high-speed intercity traffic movements.
20. Gutter. That portion of the driving surface of an improved street, driveway, approach, or other public way, which abuts the curb and provides for the runoff of surface drainage.
21. Improved Street. A public street having concrete curbs, or curb and gutters, or other such equivalent physical features, which serve to establish a permanent street grade.
22. Intersection. The general area where two or more roadways meet, join, or cross at a common point establishing an area within which vehicles traveling different roadways may come in conflict.
23. Joint Driveway. A driveway which provides access to a public street for more than one parcel of land.
24. Local Street. A street primarily providing direct access to abutting property and designed to accommodate low-volume, low-speed traffic.
25. Lot. An undivided tract or parcel of land under one ownership having access to a street, whether occupied or to be occupied by a building or building group together with accessory buildings, which parcel of land is designated as a separate and distinct tract, and is identified by a tract or lot number or symbol in a duly approved subdivision plat filed of record.
26. Owner. Any individual, firm, association, syndicate, partnership, corporation, trust, or any other legal entity having sufficient proprietary interest in the land sought to be subdivided to commerce and maintain proceedings to subdivide the same.

27. Parkway. That portion of the street right-of-way between the edges of the roadway and the adjacent property line, or lines, on the same side of the street except any portion used for sidewalks.
28. Preliminary Plat. The preliminary map, drawing, or chart indicating the proposed layout of the subdivision initially required in the subdivision process.
29. Property Description. Description of a lot, tract, or parcel by metes and bounds, by reference to a plat or by reference to government survey.
30. Property Line. The boundary between two or more parcels of land.
31. Public Improvements. Those things that are constructed, installed, or performed on public land, or on land that is to become public in the subdivision process, including but not limited to street and alley pavement, curbs, storm drainage facilities, sidewalks, and sanitary sewers, and including the grading of such land.
32. Reference Points. Points of reference located by a survey of the project. The points are to be tied or referenced to at least three identifiable features.
33. Right-of-Way. A general term denoting public ownership or interest in land, usually in a strip, which has been acquired for or devoted to the use of a street or alley.
34. Right-of-Way Line or Street Right-of-Way Line. The boundary between any public street or alley and one or more parcels of private property.
35. Roadway. That area of a street intended and used for vehicular travel.
36. Service Road. A minor street which is parallel and adjacent to an arterial street and which provides access to abutting properties and protection from through traffic.

37. Shall, May. The word "Shall" shall be deemed as mandatory. The word "May" shall be deemed as permissive.
38. Sidewalk. That paved portion of a parkway intended for the use of pedestrians.
39. Sight Distance Triangle. A triangular-shaped area of street right-of-way, generally acquired at major intersections to ensure adequate sight distance.
40. Storm Water Detention Facility. A drainage facility designed and constructed for the purpose of detaining the peak rate of storm water runoff from a specified rainstorm.
41. Streets. "Street" is a way for vehicular traffic, whether designated as a street, highway, thoroughfare, parkway, throughway, road, avenue, boulevard, lane, place, or however otherwise designated.
42. Subgrade. The surface of a street on which a base course or riding surface is to be placed.
43. Subdivision. The division of land into two (2) or more lots, tracts, or parcels for the purpose of transfer of ownership or building development, or, if a new street or easement of access is involved, any division of a parcel of land. The term includes resubdivision and, when appropriate to the context, shall relate to the process of subdividing or to the land subdivided.
44. Surveying. The act of determining the positions of points on the earth's surface by means of measurement of distance, direction, and elevation.
45. Tendering. The legal transfer of ownership and maintenance responsibility of a public improvement to the City of Springfield.
46. Unimproved Street. A street not having concrete curbs, or curbs and gutters, or other such equivalent physical features which serve to establish a permanent street grade.

47. Vehicle. Every device in, upon, or by which any person or property is, or may be transported, or drawn upon a street, except devices used exclusively upon stationary rails or tracks.

B. PUBLIC WORKS POLICIES

1. Minimum Standards for Design. The Director of Public Works must approve all plans for public improvements within the City of Springfield. This approval is a conceptual approval only and does not give detail approval to any particular design item or data shown on the plans, nor does it give approval for any deviation from City specifications unless that deviation is shown on the plans by a general note. The Engineer who sealed the plans is responsible for all lines and grades, field data, constructibility of the design, and all other items affecting the project including compliance with the City specifications.

VARIANCE FROM MINIMUM STANDARDS.

ALL DESIGN REQUIREMENTS WILL BE STRICTLY ADHERED TO UNLESS WRITTEN JUSTIFICATION FOR A DESIGN VARIANCE IS PRESENTED TO AND APPROVED BY THE ADMINISTRATIVE REVIEW COMMITTEE PRIOR TO PRELIMINARY PLAT APPROVAL.

SHOULD A REQUEST FOR A DESIGN VARIANCE OCCUR AFTER PRELIMINARY PLAT APPROVAL, AND THIS CAUSES NONCONFORMANCE WITH THE PRELIMINARY PLAT, THE PLANNING AND ZONING COMMISSION AND CITY COUNCIL WILL HAVE TO APPROVE THE AMENDMENT TO THE PRELIMINARY PLAT, AS THE AUTHORITY TO ACCOMPLISH THIS DOES NOT REST WITH THE ADMINISTRATIVE REVIEW COMMITTEE.

2. Acceptance of Public Improvements. No streets, alleys, sanitary sewers, storm sewers, or other public improvements will be accepted or approved by either the City Council or Director of Public Works, unless the improvements were constructed in accordance with Plans, Special Provisions, and Technical Specifications approved by the Director of Public Works.

3. Utility Location Policies.

- a. General. The following criteria has been established for the uniform treatment of the location or relocation of utility facilities within the right-of-way of the public street system in order to preserve the traffic-carrying capacity of the street and to minimize interference with normal maintenance operations. These requirements apply to all public and private utilities including power transmission, telephone, cable television, telegraph, water, gas, oil petroleum products, pipelines, and any other utility facilities (excluding Sanitary Sewers). The requirements apply to underground, surface, or overhead facilities located within or crossing street right-of-way. Exceptions to the requirements set forth will be considered when major utility extensions are proposed or when improvements by their size necessitate special consideration. All utilities installing any facilities in a public right-of-way must meet the requirements of the Department of Public Works and shall receive advance approval from Public Works prior to commencing construction on a public right-of-way. In order to receive approval, an engineering drawing detailing the installation shall be required. This engineering drawing shall depict adequate data to determine location and impact on other facilities located in the public right-of-way.

In the case of reconstruction or rehabilitation where location of existing utilities will not be relocated and where breaks or normal maintenance is needed, the requirement for an engineering drawing shall be waived.

- b. New Subdivisions - Residential. Parallel installations of overhead facilities within the street right-of-way are to be located within one (1) foot of the right-of-way line when proposed for construction on the same side of the street that sidewalks are constructed. Street lights and poles used to support transverse crossings of the right-of-way shall not be located closer than two (2) feet of the curb or edge of roadway or

paved shoulder. Poles, guys, anchors, braces, and other appurtenances for overhead facilities shall not encroach into sidewalk or streets. Parallel installation of overhead facilities and underground facilities, including meters, valves, and other appurtenances, within the street right-of-way, are to be located within a seven (7) foot area adjacent to the right-of-way line where no sidewalks exist. In no case will the City allow the facility to be constructed within the street pavement area except for valves necessary for tapping existing facilities, nor will it be allowed to conflict with the street drainage. Careful consideration must be given to the location of valves, meter boxes, and other appurtenances, so that interference with the sidewalk and street curb is held to a minimum. Minimum cover for all underground facilities shall be 36 inches.

- c. New Subdivisions - Nonresidential. Parallel overhead and underground facilities are to be located within seven (7) feet of the right-of-way line. Street lights and poles used to support transverse crossings of the right-of-way shall not be located closer than two (2) feet of the curb or edge of roadway or paved shoulder. Poles, guys, anchors, braces, and other appurtenances for overhead facilities shall not encroach into sidewalks or streets. Parallel installation of the underground facilities, including meters, valves, and other appurtenances, within the street right-of-way, are to be located within seven (7) feet of the right-of-way line. In no case will the City allow the facility to be constructed within the street pavement area except for valves necessary for tapping existing facilities, nor will it be allowed to conflict with the street drainage. Careful consideration must be given to the location of valves, meter boxes, and other appurtenances, so that interference with the sidewalk and curb is held to a minimum. Minimum cover shall be 36 inches or conforming to federal, state, or local agency requirements, whichever is greater.

d. Existing Subdivisions - Residential and Nonresidential. Plans developed for new underground or overhead facilities must be designed to take into account existing utilities, as well as possible future utilities. Where possible, corridors outlined in 3(b) and 3(c) are to be adhered to. Due to existing facilities, this may be impractical. Design based upon remaining corridor is encouraged, but it is understood local, state, and federal codes may make this impossible. Since existing conditions must be taken into account, deviation from the corridor requirements in 3(b) and 3(c) will be accepted.

e. Permits.

(1) City Maintained Streets. All utility work to be performed within the right-of-way limits of City-owned streets and alleys will require an excavation permit from the Public Works Department prior to the work being done by the utility or the utility's contractor. All street, curb, and sidewalk repairs will be performed by City forces at the current rates established for such repairs. In emergency situations where necessary repairs to an existing utility facility must be made immediately in order to protect the public health, safety, and welfare, a permit must be obtained as soon after emergency repairs are commenced as possible.

(2) State Maintained Streets and Highways. All utility work to be performed on state-maintained facilities will require a permit from the Missouri Highway and Transportation Commission. All requirements of the state must be met.

f. Open Cutting or Boring of City Streets.

As a general policy, no open cutting of the pavement will be permitted on the City's arterial or three- or four-lane collector streets except special permission to open cut an arterial or

collector street may be given when the street has not yet been constructed to the ultimate design or major maintenance or rehabilitation of the street surface is programmed within three (3) years of the open cut. Boring, pneumagophing, or tunneling methods will be allowed on all City-maintained streets. In cases where a break, leak, or malfunction occurs in an existing facility, or when spot lowerings or connections are made in rehabilitation, open cutting will be allowed as necessary to repair or rehabilitate the facility.

As additional arterial or collector streets are constructed or improved to ultimate standards, open cutting will not be permitted on these facilities except where breaks occur. The approved "Thoroughfare Improvement Program" lists those streets, which are planned for improvement in the near future.

g. Backfilling and Repair of Utility Cuts.

When open cutting of an existing or proposed street is approved, aggregate backfill conforming to City standards must be placed for the full trench depth and compacted to six (6)-inch layers across the street to within two (2) feet of the outside of the street curbs, as well as under all sidewalks, driveways, and other structures or pavements. Any damage to existing curbs, sidewalks, and other public improvements will be repaired and/or replaced by City forces at the expense of the utility.

h. Utilities Constructed Through Storm Sewer Structures.

Any utility found in a storm sewer structure during the course of that structure's rehabilitation or reconstruction would have to be relocated outside of the structure. Further, any new utility will be prohibited from passing through any storm sewer structure regardless of the age of the structure, and regardless of the fact that there are existing utilities in the

structure. Relocation expense will be subject to Paragraph 3(i).

i. Reimbursement to Public Utilities.

On Public Works' projects constructed either by contract or by City maintenance forces where conflicts occur with existing utilities, the utility company shall be required to relocate their existing utilities in accordance with the policies set forth in these Design Standards. Where the utility is privately owned, all costs related to the relocation will be borne by the utility.

Both the designer and the utility must make a good faith effort and agree on the approximate location of the utility. Disclaimer clauses will not be accepted as good faith effort. Charges for reimbursement must include credits for all salvageable materials and must not include costs for betterment.

## CHAPTER II - PLAN PREPARATION

### A. DRAWING STANDARDS

1. General. All engineering drawings shall be in ink or plastic lead of blueprint quality lead on mylar, and shall be of uniform size, 24"x 36". The plan sheet shall have a City of Springfield standard title block on the lower right corner of the sheet. Consultants shall place their own title block above or to the left of the City title block. Standard mylar sheets may be purchased from the City for use by private engineering firms.

The registration seal of the responsible professional engineer, licensed in the State of Missouri, shall be placed in the lower right-hand corner of each sheet of plans.

2. Drawing Scale. Engineering plan and profiles shall be prepared on a scale of 1" = 40' horizontal and 1" = 4' vertical. When requirements for detail necessitates a larger scale, a horizontal scale of 1" = 20' and 1" = 4' vertical, may be used. Drainage area maps, construction details, cross sections, and contour maps shall be drawn to a scale suitable to show complete detail.
3. Elevation Datum. Elevations for profiles and cross-sections, or at particular locations indicated on plans shall be U.S.G.S. datum. At least two permanent bench marks in the vicinity of each project shall be noted on the first plan sheet of each project, and their location and elevation shall be clearly defined.
4. Stationing and North Arrow. The top of each plan sheet shall be either north or east, and a standard north arrow should be used.

The stationing on street plans and profiles shall be from left to right, but on drainage, sanitary sewer, and storm sewer plans, the stationing shall always begin at the low point.

5. Topography. When more than one drawing sheet is required for a project, an overlap of not less than 100 feet shall be provided.

Each project shall show at least 100 feet of topography on each side. Subdivision plans shall show at least 100 feet of topography outside the plat limits. All existing topography and any proposed changes, including utilities, telephone installations, etc., shall be shown on both the plan and profile portion of the drawing.

6. Revisions to Drawings. Revisions to drawings shall be noted on the plan above the title block and shall show the nature of the revision and the date made.
7. Symbols. Typical symbols to be used in the preparation of engineering drawings are shown in the back of this chapter. Topography for which symbols have not been standardized shall be indicated and named on the plan and profile sheet. In utilizing the standard symbols for engineering plans, all existing utilities, telephone installations, sanitary and storm sewers, pavements, curbs, inlets, and culverts, etc., shall be shown with a broken line; proposed facilities with a solid line; land, lot, and property lines to be shown with a slightly lighter solid line. All easements must be shown, as well as the book and page number, if recorded.
8. Minimum Requirements. It shall be understood that the requirements outlined in these standards are minimum requirements and shall be applied when conditions, design criteria, and materials conform to the City specifications. When unusual subsoil or drainage conditions are encountered, an investigation should be made and a special design prepared in conformance with good engineering practice.
9. Owner's Name. The title sheet must indicate the owner's name and address for whom the improvements are to be constructed.
10. Dimensions. Lot lines, dimensions, and subdivision name shall be shown where applicable.
11. Cover Sheet. All plans shall have a cover sheet showing the general location of the project in relation to the Springfield City street system. The cover sheet shall show the complete project area to a

scale of 1" = 100' or an appropriate scale for small projects.

B. SUBMISSION OF ENGINEERING PLANS

1. Original Submission. Two sets of prints of the engineering construction plans for streets, sanitary sewer, and storm sewer shall be submitted to the Public Works Department for approval. The Engineer must also distribute plans to the Electric, Gas, and Water Divisions of the Engineering Department of City Utilities for their comments. All other utilities must be contacted as necessary.
2. Future Submissions. After the first submission of engineering plans, all future submissions shall consist of two sets of plans to the Public Works Department. Projects involving State highways will require the approval of the Missouri Highway and Transportation Department.
3. Originals. After final approval of the plans, the original drawings shall be brought to the Engineering Division for filing in the office of the Director of Public Works. The originals shall not be submitted until they are approved. After filing, the original drawings shall become the property of the City of Springfield.
4. Drawings on File. Original drawings on file in the office of the Director of Public Works may be checked out for revisions by the project engineer, only with approval of the City Engineering Division. Prior to checking out the drawings, a redlined print showing the proposed revisions must be submitted for approval. Drawings must be returned within one week. All revisions must be approved by the Public Works Department prior to construction.

C. PRE-CONSTRUCTION REQUIREMENTS

1. Fees. After plans have been approved and filed by the City, it is the Developer's responsibility to pay all necessary fees prior to construction.
2. Copy of Contract. A detailed copy of the construction bid, showing unit costs for all items included in the

contract, and showing the total contract value, must accompany the fee.

3. Start of Construction. No construction of public facilities shall be permitted prior to approval and filing of the plans and/or paying of fees. In addition, 24-hour notification must be given to the Public Works Construction Office prior to the commencement of any work on public facilities. No street construction will be permitted prior to completion of construction of all private and/or public utilities within the street right-of-way.
4. Easements. All easements required for construction, which are not included on the plat, shall be recorded and filed with the City prior to filing of original plan sheets.

## CHAPTER III - SURVEY REQUIREMENTS

### A. SURVEYING WORK

1. Public Relations. Survey personnel are usually the first representatives to perform work on a project and to come into contact with citizens affected by public improvements. In view of this, it is important for the personnel of the survey party to present a good impression. Doubtful or questionable information is never given to the public by the survey party. It is much better to say "That's a good question; let me refer you to the Engineering Division, Public Works."
2. Procedure. The standard sequence in making a survey for design purposes is as follows:
  - a. Safety. Provide for proper safety by using clear, easy-to-understand signing and flagmen as necessary.
  - b. Centerline. Establish and stake centerline or a baseline referenced to the centerline.
  - c. Levels. Run and adjust bench levels.
  - d. Topography. Obtain topography.
  - e. Profiles and Sections. Obtain profiles, cross sections, and culverts.
  - f. Miscellaneous. Miscellaneous surveys shall be completed.

NOTE: Some of the above procedures may be performed concurrently.

3. Survey Field Notes. All survey notes shall be kept in hardbound field books. Standard practices of neatness, uniformity, and continuity are to be exercised in preparing these field books. Notes are not to be kept on scrap paper and later copied into the field books. The field books become a permanent record, and the notes are kept with this in mind. Each field book is to be numbered on both the outside cover and on the inside fly leaf. Every field book should include an index of the contents of the book on

the first page. Each page of the field book shall be numbered and the page number utilized in the index. The members of the survey party - party chief, instrument man, and rod and chain members shall be recorded each day on the page being completed, along with the date and weather. Notes shall be kept with a 3H or harder lead pencil so that the notes will not smear. Corrections to survey notes shall be made by lining out the incorrect data and placing the correct information above it. The correction must be initialed and dated by the person making the change. Erasures will not be permitted in the field notes.

4. Accuracy. Measurements, whether linear, angular, or vertical, are to be made to the best possible accuracy consistent with the type of equipment used and the necessary speed of completing the work. Many contract items are paid for as plan quantities, which are determined and computed from survey data. This fact makes it mandatory that all survey information must be carefully and completely obtained.
5. Tolerances.
  - a. Distances. All distances shall be taped or chained to an accuracy of 0.01 foot by the use of a good quality chain utilizing proper tension. The chain is to be kept in good condition, free of splices and kinks.
  - b. Angles. All angles shall be recorded to the nearest 30 seconds. Line projections on tangents shall be double-centered to ensure against introducing slight angles caused by instrument error.
  - c. Elevations. Level elevations are to be recorded to an accuracy of 0.01 feet for benchmarks and on paved surfaces. An accuracy of 0.1 feet shall be used on all other surfaces. A total level line tolerance shall meet or exceed the value which is determined by the formula  $(.05) (\text{sq. rt. of } D)$ , ( $D$  = Distance in miles).
6. Centerline Location. Survey centerline shall be located or run on all proposed streets, for storm sewers, and sanitary sewers, or on a base line referenced to the proposed centerline. The centerline

or baseline shall be staked at every 100-foot station on tangent, and a minimum of every 25-foot station on curves. All PCs, P.T.s, P.I.s, and manhole points shall be located with 0.5-inch rods or 60d nails with cap, and shall be flagged. All section corners, lot corners, and other reference markers shall be tied to the centerline or baseline.

7. Reference Points. After the centerline has been established, reference points shall be marked as previously noted in paragraph 6, hereinbefore. The reference points shall be tied to at least three identifiable features, such as trees, fence corners, utility poles, etc. Each of these referenced features should be separated by about 120 degrees. The referenced points and the ties shall be recorded in the field notes for that project.
8. Topography. Complete topography notes shall be made of all physical features within the limits of the project. Complete topography includes all buildings, sidewalks, paved areas, shrubbery, trees, utility poles, valves, and other physical features. The notes must include complete dimensions of the items located, such as sizes of sanitary sewer lines, storm sewers, culverts, etc. Careful attention should be given to locating valves, which fix underground facilities.
9. Bench Marks. A minimum of two benchmarks must be established on all projects and shall be not greater than 1,000 feet apart. These benchmarks shall be square cuts in concrete, spikes in trees, power poles, etc. The location of benchmarks should be in areas where they will not be disturbed during the process of construction of the project.
10. Cross-sections and Profile. The cross-sections and profile elevations shall show all breaks in the natural ground elevation. Cross-sections are not necessarily taken at just even stations, particularly in rough terrain. Cross-sections and profile elevations are taken at sufficient intervals to properly represent the true terrain. In flat terrain, cross-sections are to be taken at a maximum spacing of 100 feet. Special care should be exercised to assure that cross-sections are taken at right angles to the centerline.

All intersecting streets shall be profiled and cross-sectioned. All existing manholes, junction boxes, inlets, and storm sewers shall show flow lines, sizes, and top of cover elevations.

A culvert section (a profile along centerline of the culvert) is to be taken at all locations where drainage is to be carried across proposed streets. A sufficient distance right and left of the street centerline is to be profiled to properly determine the proposed flow line elevations.

## CHAPTER IV - EARTHWORK

### A. EMBANKMENT CONSTRUCTION

All embankments required for construction of public streets and alleys must be compacted. The method of compaction and densities are as required in the latest revision of the City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction. All trees, shrubs, and plants designated to remain within the public right-of-way shall be shown and clearly noted on the plans. All other plantings shall be removed from the right-of-way. The plans shall require that the public right-of-way be left in a finished and neat appearing condition.

### B. SUBGRADE COMPACTION

The plans shall require that the street subgrade for both public and private improvements be compacted as required in the latest revision of the City of Springfield Standard General Conditions and Technical Specifications Public Works Construction. All street sub-grades shall have at least 4" of compacted aggregate (meeting Type I Aggregate Base requirements) base. Aggregate should extend 1' - 0" outside the limits of the street.

## CHAPTER V - SANITARY SEWERS

### A. GENERAL

1. Materials. All materials used in the construction of sanitary sewers shall conform to the latest revision of the City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction unless specifically designated otherwise by special provision drawings and prior approval is obtained.
2. Discrepancies. Where discrepancies between standard details, drawings and/or special provisions occur, the special provisions shall govern.
3. Structures. Whenever possible, structures shall be constructed as shown in the standard details. Structures other than those shown in the standard details shall be considered to be special structures and must be designed and detailed by the design engineer.
4. Construction on Fill. Where a sewer must be constructed on fill, a profile of the original undisturbed ground line along sewer centerline shall be shown. All sewers to be constructed on fill must have a special design approved by the Public Works Department.
5. Tendering. Tendering of the sanitary sewer line and appurtenances must be made prior to acceptance of the sanitary sewers by the City.

### B. SANITARY SEWER DESIGN

1. Design Period. Sanitary sewer systems must be designed for the estimated ultimate tributary population. Consideration should be given to the maximum anticipated capacity of institutions and industries.
2. Design Factors. In determining the required capacities of sanitary sewers the following factors shall be considered:
  - a. Maximum hourly quantity of sewage.

- b. Additional sewage volume or waste from industrial plants.
- c. Ground water infiltration.

3. Design Basis.

- a. Per Capita Flow. Sewer systems shall be designed on the basis of the maximum hourly flow of three (3) times the average daily per capita flow of sewage. In no case shall the average daily per capita flow be considered less than one hundred (100) gallons per day. This figure is assumed to cover normal infiltration, but an additional allowance should be made where ground conditions are known to be unfavorable and industrial wastes are present.
- b. Alternative Method. When deviations from the foregoing per capita rates are warranted, a brief description of the proposed procedure to be used for the sewer design shall be included. The Department of Public Works recommends 2,500 to 3,000 GPD per acre for single-family gross area exclusive of sewage or other waste from industrial plants.

4. Design Details.

- a. Minimum Size. No public sewer shall be less than eight inches in diameter.
- b. Location. Sewers shall be placed in street right-of-way where feasible. Plans shall show the stationing of all in-line tees.
- c. Depth. Sewers shall be designed deep enough to prevent freezing, and to allow house connections to cross under water mains at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer line. If the proposed sewer is parallel to a water main, it shall be designed to provide a minimum 18-inch vertical clearance or a minimum 10-foot horizontal clearance from the water main. Unless approved by the Director of Public Works,

no sewer shall be designed and/or constructed that will not provide a minimum depth of four (4) feet to top of pipe. All PVC sewers over 12' deep shall be SDR 21, Class 200 pipe. All sewers over 12' deep shall have a minimum of 12" of aggregate bedding material over the top of the pipe.

- d. Slope. All sewers shall be designed and constructed so as to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Mannings formula using an "n" value of 0.013.
- e. Slope calculations and detailing. The slope on all sewer lines shall be calculated from inside wall of manhole to inside wall of manhole.

The following are the minimum slopes, which should be provided; however, slopes steeper than these are desirable.

Sewer Size	Minimum Slope in Feet per 100 Feet
8"	0.40
10"	0.28
12"	0.22
14"	0.17
15"	0.15
16"	0.14
18"	0.12
21"	0.10
24"	0.08

The velocity of flow in sewers shall not exceed 12 feet per second. If necessary, a drop manhole shall be provided to reduce the velocity. Sewers shall be laid with uniform slope between manholes. The maximum slope for all main line sewer pipes shall be 10%. The minimum slope for all laterals shall be ¼ inch per foot, unless otherwise approved.

- f. Loading. All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made because of the width and depth of trench.

- g. Grade through Manholes. A drop of 0.2 feet shall be shown through manholes. The flow line of new sewer lines coming into a main sewer manhole should be at least one half the diameter of the trunk sewer above the flow line of the trunk sewer.
- h. Increasing Size. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient.
- i. Alignment. Sewers in streets should be placed in or near the center of the street where possible. Sewers located at back property lines should be about two feet to one side of the property line and on the opposite side from pole lines or other utilities. The ends of sewer lines should extend at least fifteen feet beyond the property line of the last lot served, to provide room for the house connection with a tee below the manhole. Cutting corners and running diagonally across streets is not allowed. Curved sewer alignment may be permitted on a case-by-case basis, provided the minimum radius of curvature is not less than 300 feet, the maximum deflection of any individual joint is not more than two (2) degrees, and the areas being sewered are presently developed (streets are in place). Tracer wire shall be laid within 6 inches from top of pipe. Wire shall be brought up at manholes and securely anchored to manhole frame with galvanized bolt.

A minimum permanent easement of 5' either side of sewer is required. A temporary construction easement shall be provided, as necessary. All crossing and/or cutting of streets must be backfilled with granular material. All sewers with a trench wall within two feet of the back of the street curb shall be backfilled with granular material.

5. Relation to Water Mains or Storm Sewers.

- a. Horizontal Separation. Wherever possible, sewers should be laid at least 10 feet, horizontally, from any existing water main or storm sewer. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main or storm sewer if:
  - (1) It is laid in a separate trench, or
  - (2) It is laid in the same trench with the water mains or storm sewer located at one side on a bench of undisturbed earth, and
  - (3) In either case the elevation of the top (crown) of the sewer is at least 18" below the bottom (invert) of the water main or storm sewer.
- b. Vertical Separation. Whenever sanitary sewers must cross under water mains or storm sewers, the sanitary sewer shall be laid at such an elevation that the top of the sanitary sewer is at least 18" below the bottom of the water main or storm sewer. When the elevation of the sanitary sewer cannot be varied to meet the above requirement, the water main or storm sewer shall be relocated to provide this separation.

When it is not feasible to obtain proper horizontal and vertical separation as stipulated above, the sewer must be constructed of SDR 21, Class 200 pressure water line pipe and must be air tested at a pressure not less than four (4) pounds per square inch for five (5) minutes to assure water tightness. A manhole must be located at each end of the pressure pipe; and the near side of the manholes can be no closer than ten (10) feet from the water main.

No water line shall pass through or come into contact with any part of a sanitary sewer manhole.

6. Manholes.

- a. Location. Manholes shall be installed at all changes in grade, size or alignment, at all intersections, and at intervals of not more than 500 feet for sewers 15 inches in diameter or less, and 600 feet for sewers 18" and larger in diameter.
- b. Drop Type. A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24" or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition; manholes, where the difference in elevation between the incoming sewer and the manhole invert is greater than 24 inches but less than 36 inches will not be allowed. Special design is required for connection to manholes with interior linings. Manholes to be connected to the James River Trunk Sewer must be constructed in accordance with Standard Drawing SAN-13 included in Chapter XII of these specifications.
- c. Diameter. The minimum diameter of manholes shall be 48 inches (4 feet), and shall conform to the latest revision of the City of Springfield Standard General Conditions and Technical Specifications. All inside drop manholes shall have a minimum diameter of 60 inches (5 feet).
- d. Manhole Covers. All sanitary sewer manhole covers shall be Type "A," non-rocking.
- e. Stationing and Elevation. Stationing and elevations should be shown at all M.H. locations.

7. Lampholes. Lampholes may be permitted upon the approval of the Department of Public Works. Lampholes will be permitted only in cases where the slope of the land will not permit a future extension of the sewer beyond the proposed lamphole. The maximum length to the nearest manhole shall not be greater than 150 feet. Lampholes will not be permitted within street surfaces.

C. DRAWINGS AND DOCUMENTS TO BE SUBMITTED

1. Sewer Drawings. Sewer drawings shall be prepared on plans separate from other utilities. District, Section, and Public Works file numbers shall be obtained from the Department of Public Works.
  - a. Plan. The plan shall be at the top of the drawing. Standard symbols shall be used. A standard north arrow shall be located on each sheet (pointing up or to the right).
    - (1) Scale shall be 1" = 40' horizontal for undeveloped areas and 1" = 20' for developed areas.
    - (2) Method of Indicating Location. Sewers and manholes within streets and adjacent developed areas shall be located in plan by dimensions from property markers or other well-defined physical features.
  - b. Profile. The profile shall be shown under the plan.
    - (1) Scale. Scale shall be 1" = 4' vertical, and 1" = 40' horizontal for undeveloped areas and 1" = 20' for developed areas.
    - (2) Grades. Established elevations of existing manholes shall be obtained from the Department of Public Works, and then verified in the field. When such grades are not available, they shall be established by the design engineer and submitted to the Department of Public Works for approval. Existing ground and proposed pavement over sewer shall be shown and labeled. Existing or proposed building floor elevations or sufficient ground elevation 100 feet either side of centerline shall be shown to determine required depth and slope of service lines.
  - c. Utilities. Existing and proposed utilities shall be accurately and clearly shown in plan and

profile. Elevations of existing utilities shall be obtained where possibility of conflict exists.

- d. Location and Design Information. A cover sheet shall be Sheet No. 1 of the drawings, indicating the entire area to be served by the proposed sewers and indicating the sheet number on which each segment of sewer line is drawn. The scale shall be 1" = 100'. When this cannot be done without attaching an extra drawing, then the scale will be 1" = 200'. Proposed district boundaries shall be shown with sufficient data that a written district boundary description may be described from it, and a written boundary shall be attached to the drawing. Also, all lots, blocks, and the location of proposed sewer lines shall be known. When the cover sheet will not show at least two well-known streets or routes, a small location map shall be added to the cover sheet showing the location of the project. Benchmarks based on USGS datum shall be shown on the drawings as per the Survey Requirements included as Chapter III of these Design Standards. The Department of Public Works will review the plans to determine its compatibility with the entire drainage area. The developer or owner's name shall be shown on the cover sheet along with the subdivision name.

#### D. LIFT STATIONS

##### 1. General.

- a. A sewage lift station shall consist of a wet well, sewage pumps, control systems, electrical systems (normal and emergency), superstructures, site security systems, grading, and access.

The purpose and goal of a lift station is to serve as a sewage collection point for a development and to pump that sewage to a gravity line serving the area in a safe, economical, and easily-maintained manner.

2. Buildings and Grounds.

- a. Flooding. Sewage pumping stations shall not be subject to flooding due to storm water runoff. A suitable superstructure located off the right-of-way of streets and alleys shall be provided.
- b. Fencing. A fence surrounding the station site shall be provided. The fence shall be eight (8) feet high (minimum) with a twelve (12)-foot wide, double-leaf gate. The fence shall be galvanized chain link except where subdivision rules require a wooden privacy fence. Supporting posts for all types of fences shall not be more than eight (8) feet apart and be concrete encased below grade. Minimum bury depth of posts to be two and one-half (2-½) feet. Wooden fences shall be constructed of pressure treated or other approved weather resistant wood. Wooden support posts shall be 4" x 4" minimum. The gate is to be located so that entranceway does not go over manholes. The pump station and generator unit is to be easily accessible for maintenance from entranceway. The gate is to be set back twenty-five (25) feet from edge of road.
- c. Surfacing of Lift Station Area. The area inside the fence must be constructed of four (4) inches of Type 1 aggregate, compacted according to City Specifications, on a four (4) mil polyethylene sheeting placed over the entire enclosed area. This sheeting shall have one (1)-inch diameter perforations spaced not more than two feet in each direction. Prior to placing the sheeting, the soil to be covered is to be treated with a soil sterilant Diuron (Karmex by DuPont), or equal, and applied as directed by the manufacturer.
- d. Accessibility to Site. The pump station must be accessible by an acceptable all-weather, hard-surface road meeting the same requirements as other roads in the development. Junction of pump station road and public street shall have a minimum sixteen (16)-foot-long culvert of acceptable diameter in ditch if necessary.

- e. Outside Lighting. An outside weatherproof pole-mounted, high-intensity discharge lighting fixture of not less than 175 watts with an electrical eye with dusk-to-dawn operation shall be provided. The light is to be of the high-pressure sodium type with electric eye for dusk-to-dawn operation.
  - f. Switching Gear and Controls. Generator unit, switching gear, and controls to be mounted inside a weatherproof building with four (4) feet (minimum) clearance on each side of generator unit, with a minimum height of eight (8) feet. The building may be a wood frame, metal or masonry building mounted, and attached to a six-inch non-reinforced concrete floor.
3. Design. The following items should be given consideration in the design of sewage pumping stations:
- a. Type. Sewage pumping stations may be either suction-lift type or submersible. When total suction lift exceeds fifteen (15) feet, only the submersible type will be permitted. When GPM from one pump is 700 GPM or greater, a dry well/wet well-type station would be acceptable.
  - b. Structures.
    - (1) Separation. Wet and dry wells including their superstructure shall be completely separated.
    - (2) Pump Removal. Provision shall be made to facilitate removing pumps and motors.
      - (a) Submersible pump stations shall have a slide coupling and guide rails lifting system. A stainless steel lifting cable, with one end permanently attached to the pump-lifting lug and the other end secured at grade level, shall be provided.

- (b) Dry well/wet well stations shall have a hoist and trolley system to lift and move the pumps to the access opening.
  - (c) Suction lift stations shall have lifting arm for removing motor and pump from base.
  - (d) Where pump station is enclosed in a building, equipment shall be provided for moving pumps and motors to the access doorway.
- (3) Access. Suitable and safe means of access shall be provided to dry wells of pump stations and shall be provided to wet wells containing either bar screens or mechanical equipment requiring inspection and maintenance. Stairways or ladders exceeding fifteen (15) feet shall not rest landings at vertical intervals not exceeding ten (10) feet.

c. Pumps.

- (1) Duplicate Units. At least two (2) pumps shall be provided. If only two (2) units are provided, they must have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where more than two (2) units are provided, each shall be designed to fit maximum flow conditions and must be of such capacity that with any one unit out of service the remaining units will have capacity to handle maximum sewage flows.
- (2) Protection Against Clogging. Where the size of the lift station is 700 g.p.m. or greater, a trash rack located below floor level shall be provided. Where screens are located below ground, facilities must be provided for handling screenings.
- (3) Pump Openings. Pumps shall be capable of passing spheres of at least three (3) inches in diameter. Pump suction and discharge

openings shall be at least four (4) inches in diameter.

- (4) Priming. The pump shall be so placed that under normal operating conditions it will operate under a positive suction head, except as specified for suction-lift pump stations. Each suction-lift pump shall have a priming system independent from other pumps.
- (5) Intake. Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake.
- (6) Dry Well Dewatering. A separate sump pump shall be provided in the dry wells to remove leakage or drainage with the discharge above the overflow level of the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkways surfaces shall have an adequate slope to a point of drainage.
- (7) Submercible Pump Seals. Tandem mechanical seals are required on submercible pumps.

d. Valves. A shut-off valve shall be placed on suction and discharge lines of each pump. A check valve with external arm shall be placed on each discharge line between the shut-off valve and the pump. An external arm check valve is required with a lever-operated micro switch for telemetering purposes. These valves shall be located outside of the wet well and shall be readily accessible for repairs.

e. Wet Wells.

- (1) Grit. Where it may be necessary to pump sewage prior to grit removal, the design of the wet well should receive special attention and the discharge piping shall be designed to prevent grit settling in pump discharge lines of pumps not operating.

- (2) Divided Wells. Where continuity of pumping station operation is required, consideration shall be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning.
  - (3) Floor Slope. The wet well floor shall have a minimum slope of one (1) to one (1) to the hopper bottom.
- f. Ventilation. Adequate ventilation shall be provided for all pump stations. Where the pump pit is below grade, mechanical ventilation is required. In dry well/wet well stations, mechanical ventilation is required when screens or other mechanical equipment requiring maintenance or inspection is located in the wet well. There shall be no interconnection between the wet well and dry well ventilation systems. In pits over fifteen (15) feet deep, multiple inlets and outlets are required. Dampers shall not be used on exhaust or fresh air ducts, and fine screens or other obstructions in air ducts shall be avoided to prevent clogging. Switches for operation of ventilation equipment shall be marked and located at grade level. Ventilation equipment and lighting shall be energized when lid is open on dry well type stations. The fan wheel shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment is required when station is located below grade level.
  - (1) Wet Wells. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least twelve (12) complete air changes per hour; if intermittent, at least thirty (30) complete air changes per hour. Such ventilation shall be accomplished by introduction of fresh air into the wet well by mechanical means.
  - (2) Dry Wells. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least six (6) complete air changes per hour; if

intermittent, at least thirty (30) complete air changes per hour.

- g. Water Supply. Potable water shall be supplied; however, there shall be no physical connection between the potable water supply and a sewage pumping station. Potable water supply line shall not be smaller than one-half (1/2) inch. A freeze-proof hydrant with hose bib shall be located within ten (10) feet of pumping station but not in the traffic path.
- h. Dry Well Covers and Lids. Covers shall be made of lightweight, weather-resistant material and constructed so that it may be easily opened by one person. If force required to open cover is in excess of fifty (50) pounds, shock absorbers or opening springs must be provided.
- i. Spare Parts. Pump stations are to be provided with two (2) mechanical seals and two (2) gasket kits to install with seals. If seal filters are used, six (6) spares are to be included. Two (2) complete sets of contacts and coils for starters and one (1) spare alternator relay or timer shall also be furnished.
- j. Force Main Interface. A force main interface consisting of piping, a 45-degree "Y," 45-degree elbow, and flanged, full-flow valve shall be provided.
  - (1) All pipe and fittings shall be the same material and the same size as the force main.
  - (2) The interface shall be constructed within a four-foot manhole of required depth located external from but adjacent to the pump station.
  - (3) A standard manhole frame and cover shall be installed flush with finished grade.
- k. Special Requirements for Suction-Lift Pump Stations. In addition to the previously

mentioned requirements for suction-lift stations, the following shall apply:

- (1) Priming. Suction-lift pumps shall have a reliable record of satisfactory operation and be installed with a single piece suction line braced to the side of wet well. Priming shall be by dual vacuum systems independent of each other.
- (2) Capacity. Approval will be restricted to installations where total suction-lift does not exceed fifteen (15) feet.

1. General Electrical Requirements. All electrical equipment and wiring shall comply with the latest revision of the National Electrical Code. Particular attention should be given to electrical equipment enclosed in places where gas may accumulate (hazardous areas). Submersible pumps are considered to be in a hazardous area and shall be rated explosion proof by Underwriters Laboratory. This rating shall include pumps, removal systems, and controls. Vacuum primed pump controls systems must be operated through intrinsically safe relays for hazardous locations. All conduit shall be of galvanized rigid type and shall be installed below grade wherever possible. Dry-type transformers for 110-Volt utility service and control systems power shall be provided.

- (1) Primary power to the station shall be no higher than 480 Volt, 3 Phase, and shall be provided by connection to a commercial utility service. A single disconnect is to be provided between the pump station and the utility.
- (2) Emergency Operation. Provision of an emergency power supply for pumping stations shall be made, and may be accomplished by connection of the station to a second independent public utility source or by provision of in-place engine generator.

- m. Controls. Control of pumps shall be by floating mercoïd switches, normally open type. Minimum of four (4) switches shall be provided. The switches shall be used to indicate "PUMPS OFF," "FIRST PUMP ON," "SECOND PUMP ON," "HIGH LEVEL ALARM." The control panel shall include automatic pump alternation to equalize operating time on all duplex components. Elapsed time meters to be calibrated in one-tenth (0.1) hour increments on all pumps. Provisions shall be made to bypass the alternator in the event that either pump is out of service for maintenance. Motor starter coils to be rated 100 Volts, 50 Hertz. On larger lift station installations other control systems may be required. Hand-off-auto switch and elapsed time meters to be visible and operable through control panel door.
- n. Alarm Systems. Alarm systems shall be provided for all pumping stations. Equipment shall be a microprocessor base with synthesized speech and design to operate on a single-party, pulse-dial telephone circuit. All necessary equipment shall be provided to transmit the following alarms: 1. High wet well liquid level; 2. Power failure; 3. Transfer to emergency power source; 4. Generator failure; 5. Pump No. 1 running; 5. Pump No. 2 running. Other alarm features may be required based upon pump station design.
- o. Power Generating Equipment.
  - (1) General. The power module shall consist of an engine, generator, and control panel assembly, all mounted with antivibration mounts onto a fabricated steel skid base. An automatic transfer switch may be mounted separately or in the control panel assembly to automatically switch to emergency power in the event of commercial power failure. The engine generator shall be sized for starting one (1) pump and all auxiliary loads, with an additional 50% overload capacity. The complete power module shall be factory assembled and factory tested to ensure that all controls and protective devices are in proper working order. The

motor starting capability shall be tested by a simulation of the exact operating load, with certified test results provided. The power module must be coordinated with the pump station.

- (2) Engine. The engine shall be multi-cylinder, 4-cycle, and water-cooled. Water-cooled engines shall be provided with mounted radiator, fan and water pump with anti-freeze added to the cooling system to bring it to 20 degrees F. below zero protection. The fuel system shall consist of a carburetor with an automatic choke and an electric shutdown solenoid, and a dry-type air cleaner. The engine shall run on any reputable commercially available natural gas with minimum low-heat value of 950 BTU/cubic foot. The governor shall be capable of 3-5% speed regulation from no load to rated load. The lubrication system shall be force fed by gear oil, pumped to all connecting rods, main bearings, and rocker arms. Oil filter shall be spin-on, full-flow type. Engine may be operated continuously when tipped up to 15 degrees in any direction. The engine starting system shall consist of a 12-volt battery and a 12-volt Bendix-type drive, solenoid-equipped electric starter. The charge on the battery shall be maintained by a 32-amp or larger charging alternator. A water-cooled engine shall be equipped with a jacket water heater to aid in starting and engine longevity.
- (3) Alternator. The alternator shall be a full 3-phase, 4-pole, self-excited, brushless, revolving field type with static exciter. It shall be self-regulated and designed specifically for motor starting application. The alternator shall be directly connected to the engine flywheel housing and driven through a semi-flexible driving flange to ensure permanent alignment. It shall have drip-proof construction. Voltage regulation shall be within plus or minus 5% of rated voltage from no load to full load.

Insulation shall be Class F with a 70 degree C maximum temperature rise. A completely wired and assembled generator control panel shall be furnished. It shall contain the following items: 1. One ammeter with phase selection switch; 2. One voltmeter with phase selection switch; 3. One vibrating-vane type frequency meter; and 4. Integral battery charger 0-10 amp. 6. A line circuit breaker for alternator output leads.

- (4) Automatic Transfer Switch. The automatic transfer switch shall be a mechanically-held, double throw. The transfer action must be completely electrical and not rely on springs or counterweights. Operating coils must be momentarily energized from the source to which the load is being transferred. The switch must be interlocked both mechanically and electrically to prevent both sources from feeding the load at the same time. Electrical operation must not allow a neutral position. The main contacts of the transfer switch shall meet with a rolling and wiping action. They shall be copper with cadmium plating up to and including 100 amps and silver plating on all sizes above 100 amps. They shall be rated for all classes of load to 480 volt AC and equipped with blowout coils and arc chutes. They shall have air inrush current rating of 20 times rated current and an interrupting capacity of 1.5 times rated current. The transfer switch shall include auxiliary contacts to provide for the locking out of the standby pump and connection to alarm system. It shall also have three voltage-sensitive relays with dropout 70-80% adjustable pickup at 90%. Upon sensing of under-voltage condition, the generator startup and transfer sequence shall be initialed automatically. Provision shall also be made to manually initiate the sequence.

- (5) Engine Control Panel. The engine control panel is to include five (5) ten-second-

on/10-second-off cranking cycles, a switch for testing the automatic operation, a switch for deactivating the automatic operation, an oil pressure gauge, coolant temperature gauge, battery charging DC ammeter, elapsed time meter, indicating lights for fail-to-start, line-power-on, and standby-power-on, protective shut-down, with indicating lights for engine overspeed, low oil pressure, overload, high coolant temperature, manual start-run-stop switch, 0-60-second time delay on transfer Normal to Emergency, 0-30-minute time delay on transfer Emergency to Normal, 0-5-minute time delay after transfer to normal for engine cool down, contacts to signal emergency power on, contact to signal fail-to-start, contact to signal protective shut-down and fail-to-start, and a weekly exercise timer.

- (6) Placement. The unit shall be bolted in place. Facilities shall be provided for unit removal for purposes of major repair or routine maintenance.
- (7) Engine Location. The unit internal combustion engine shall be located above grade with exhaust muffler and outlet located outside of housing. The muffler system shall be residential type or better. Exhaust sleeve from building to be approved by National Fire Protection Association Code.
- (8) Engine Cooling Ventilation.
  - (a) Cooling air shall be provided by venting from the outside to the engine. The vent shall be properly located and sized to assure an adequate air supply. Vents to have screen on inside to prevent bugs and birds from entering.
  - (b) Engine housing shall have adequate ventilation to maintain a safe equipment operating temperature.

- (9) Emergency Power Generation. All emergency power generation equipment shall be provided with instructions indicating the essentiality of routinely and regularly starting and running each unit at full load.
- (10) Generator Spare Parts. Generator spare parts are to include one (1) spare circuit board of each type used, or provide a means for bypassing and testing circuits.

4. Acceptance of Lift Station.

- (a) Shop Drawings. Shop drawings shall be submitted on lift station, stand-by power source and structures, and be approved prior to installation. Three (3) copies are required.
- (b) Testing. Prior to acceptance of lift stations by the City, testing of each equipment item shall be required in the presence of the Contractor, a City representative, and the equipment manufacturer's representative. Final acceptance will not be made until all deficiencies are corrected and retesting is performed.
- (c) As-Builts. Prior to acceptance of operation of lift station, generator units, and other related appurtenances by the City, one (1) set of mylar reproducible and three (3) sets of prints of "As-Builts" shall be submitted.
- (d) Operation and Maintenance Manuals. Four (4) complete sets of operational instructions shall be provided to include emergency procedures, maintenance schedules, maintenance manuals, and service manuals on all equipment. Special tools and such spare parts as may be necessary shall be furnished to the City for the facilities to be accepted.

E. FORCE MAINS

- 1. Velocity. At design average flow, a cleansing velocity of at least four (4) feet per second shall be maintained.

2. Air Release Valve. An APCO Sewage Air Release Valve Model 401, or approved equal, shall be placed at high points in the force main to prevent air locking. A standard four-foot diameter manhole with standard frame and cover to be installed around force main and relief valve for maintenance access to valve.
3. Connection to Gravity System. The force main shall connect to the gravity sewer system at a point not more than two (2) feet above the flow line of the receiving manhole.
4. Design Pressure. The force main pipe and fittings shall be designed to withstand normal pressure and pressure surges.
5. Thrust Blocks. Concrete thrust blocking shall be provided at all bends 22 ½ degrees or greater.
6. Force Main Pipe. All force main pipe shall be P.V.C. AWWA C-900; however, SDR-21, Class 200 pipe will be required unless calculations are provided to verify that a lesser class of pipe is adequate. Pipe types less than Class 200 must be shown on the plans.
7. Depth. Force main pipe shall be designed and so constructed to provide a minimum depth of three (3) feet of cover over the top of the pipe.
8. Casing. Force mains designed to cross public streets must be encased with either reinforced concrete pipe or steel casing of adequate size to allow for future removal of the force main pipe.
9. Testing. Testing of the force main is required in accordance with the requirements of AWWA C-600. Testing pressure shall be: Total Design Head x 0.433 x 1.5. (Note: This must be shown on the plans.)

## CHAPTER VI - STORM SEWER AND DRAINAGE DESIGN

### A. MINIMUM REQUIREMENTS FOR STORM SEWER AND DRAINAGE DESIGN

1. Drainage Area Plan. A plan of the drainage area at a scale of 1" = 100' with 2' contour intervals using USGS Datum for areas less than 100 acres or a plan of the drainage area at a scale of 1" = 300' with 5' contour intervals for larger areas. This plan shall include all proposed streets, drainage, and grading improvements with flow quantities and direction of flow at all critical points. All areas and subareas for drainage calculations shall be clearly distinguished.
2. Hydraulic Data. Complete hydraulic data showing all calculations shall be submitted. A copy of all nomographs and charts used in the calculations shall be submitted if other than those included in the back of this chapter.
3. Plan and Profile. A plan and profile of all proposed improvements at a scale of 1" = 40' horizontal and 1" = 4' vertical shall be submitted. This plan shall include the following:
  - a. Location, sizes, flow line elevations and grades, type of pipe, channels, boxes, manholes, and other structures drawn on standard plan-profile sheets.
  - b. Existing and proposed ground line profiles along centerline of the drainage improvement.
  - c. A list of the kind and quantities of materials.
  - d. Typical sections and reinforcement of all boxes and channels.
  - e. Location of property lines, street paving, sanitary sewers, and other utilities.
4. Field Study. A field study of the downstream capacity of all drainage facilities and the effect of additional flow from the area to be improved shall be submitted. If the effect is to endanger property or

life, the problem must be solved before the plan will be given approval.

5. Storm Water Flow Quantities. Storm water flow quantities in the street shall be shown at all street intersections, all inlet openings, and at locations where flow is removed from the streets. This shall include the hydraulic calculations for all inlet openings and street capacities. Street flow shall be limited according to Table 1 at the back of this chapter.
6. Sinkholes or Karst Areas. Sinkholes or karst areas shall be clearly defined. If any portion of the storm water from an area is to be drained into a sinkhole, all information available shall be obtained, and the capacity of the sinkhole shall be studied, and this study shall be submitted to determine the effect of the drainage and pollution on ground water and streams.
7. Additional Information. Any additional information deemed necessary by the Director of Public Works for an adequate consideration of the storm drainage effect on the City of Springfield and surrounding areas must be submitted.

B. REQUIREMENTS RELATING TO IMPROVEMENTS

1. General Design Requirements.
  - a. All bridges shall be designed to accommodate a 100-year frequency rain. Box culverts, pipe culverts, channels, and ditches shall be designed to accommodate a 100-year frequency rain at all locations having a drainage area in excess of 1.0 square mile. Locations having a drainage area of less than or equal to 1.0 square mile shall be designed to accommodate a 25-year frequency rain.
  - b. Channel improvement types shall be as follows:
    - (1) Improvements with a capacity of up to and including 10 C.F.S. shall be open and (a) sodded; or (b) concrete paved invert; (c) concrete lined; or (d) closed conduit.

- (2) Improvements with a capacity above 10 C.F.S. up to and including 100 C.F.S. shall be closed conduit.
- (3) Improvements with a capacity above the 100 C.F.S. up to and including 250 C.F.S. may be open and (a) concrete paved invert; or (b) concrete lined; or (c) closed conduit.
- (4) Improvements with a capacity above 250 C.F.S. shall be open and (a) concrete lined; or (b) have a 100 C.F.S. low flow paved invert.

2. Specific Requirements for Various Improvements.

- a. Bridges and Culverts. Bridges, box culverts, or concrete pipe culverts shall be provided where continuous streets or alleys cross watercourses. The structure shall be designed in accordance with City specifications for materials and to carry HS-20 loadings in all cases.
- b. Closed Storm Sewers. Closed storm sewers shall either be reinforced concrete box or pipe of approved type designed for HS-20 loadings. Reinforced concrete pipe or reinforced concrete boxes must be used within two (2) feet of the back of the street curb and under paved areas. All storm sewers having trench walls within two (2) feet of the back of the street curb shall be backfilled with granular material. The use of corrugated steel, zinc-coated pipe, and extra-strength clay pipe, will not be permitted within two (2) feet of the curb or under pavement areas. All pipe materials shall meet the requirements of the latest revision of the City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction.

Grades for closed storm sewers shall be designed so that the velocity shall not be less than three (3) feet per second nor exceed twelve (12) feet per second. All other structures such as junction boxes or inlets shall be in accordance with the Standard Drawings included in Chapter XII, herein.

Closed storm sewers shall extend to the furthestmost downstream point of development with consideration given to velocities and to providing discharge energy dissipaters to prevent erosion and scouring along downstream properties.

- c. Open Paved Concrete Channels. Grades for open paved channels shall be designed so that the velocity shall not be less than three (3) feet per second nor exceed twelve (12) feet per second. Such concrete channels may be of different shapes according to existing conditions; however, a channel with a flat bottom and 4:1 to 5:1 side slopes is the most desirable type and shall be used whenever possible. The thickness of channel paving shall depend on conditions at site and size of channel; however, a minimum thickness of six (6) inches is required. A six (6)-inch freeboard must be provided. An 18-inch toe wall is required at both the outlet and inlet ends of the channel.
- d. Open Ditches (Earth Channels). Ditches shall have a gradient that limits the velocity within 1.5 to 5.0 feet per second depending on existing soil conditions. Such ditches shall have a minimum side slope ratio of 3:1. The designer's attention is directed to the fact that the subdivision ordinance prohibits encroachment of buildings and improvements on natural or designated drainage channels or the channel's flood plains. Such flood plains are areas of land adjacent to an open-paved channel or an open-sodded ditch that may receive a flood condition from a 100-year frequency rain. The limits of such flood plains shall be indicated on drainage improvement plans.

#### C. RUNOFF CALCULATIONS

The rate of runoff concentrated at any point shall be determined by the Rational Formula:

$Q = CIA$ , in which

$Q$  = Runoff in cubic feet per second

$C$  = The runoff coefficient for the area

I = Design rainfall intensity in inches per hour over the area based on time and concentration and rainfall intensity curves included as a part of this chapter. A five (5)-minute time of concentration is the minimum permitted.

A = Drainage area, in acres.

1. Runoff Coefficient. The run-off coefficient "C" is the variable in the Rational Formula least susceptible to precise determination and the one, which requires the greatest exercise of engineering judgement because of the many area characteristics, which affect the coefficient. Among the factors to be considered in influencing the runoff coefficients are the following: Present and future zoning; terrain; local ponding or depressions; the amount of pavement; roofs, turf, and other areas having different degrees of imperviousness.

The selection of a coefficient should take into consideration the probable ultimate development of presently underdeveloped areas. Suggested values of runoff coefficients are included in the following table:

SUGGESTED RUNOFF COEFFICIENTS "C"

<u>"C" Value</u>	<u>Surface Conditions</u>
.10 - .15	Tall grass, brush
.15 - .20	Parks, golf courses, farms, and one-acre, single-family residences
.35	Single family residences on lots of not less than 15,000 square ft.
.45	Single family residences on lots of not less than 10,000 sq. ft.
.47	Single family residences on lots of not less than 7,500 sq. ft.
.51	Single family residences on lots of not less than 6,000 sq. ft.
.90	Gravel Surfaces

.95	Asphalt and concrete surfaces
1.00	Buildings and other structures

2. Rainfall Intensity. The average frequency of rainfall occurrence used for design determines the degree of protection afforded by a drainage system.

Maximum intensity of rainfall of a given expectancy is greater for a short period of time than for longer periods. Therefore, it is assumed that the maximum runoff will occur as soon as all parts of the drainage area under consideration are contributing. The length of time from the beginning of rainfall until runoff from the most remote point in the drainage area reaches the point under consideration is called the time of concentration. This may include overland flow time and channel or gutter flow time. Nomographs, which may be used for determining time of concentration, are reproduced at the end of this chapter. Once the time of concentration is known, the design intensity rainfall may be determined from the rainfall intensity curves developed from Weather Bureau data included at the end of this chapter.

#### D. SIZING OF STORM SEWERS AND DRAINAGE STRUCTURES

The size of closed storm sewers, open channels, culverts, and bridges shall be designed so that their capacity will not be less than the runoff computed by using the Manning Formula:

$$Q = \frac{1.486}{n} a r^{2/3} s^{1/2}$$

Q = Capacity = Discharge in cubic feet/sec.

a = Cross-sectional area of water in conduit or channel in square feet

r = Hydraulic radius of water in conduit or channel = area/wetted perimeter

s = Mean slope of hydraulic gradient in feet per foot

n = Roughness coefficient, based on condition and type of material of conduit or channel lining.

Values of "n" for various kinds of pipe for use in Manning Formula

Concrete Pipe - 0.013  
Corrugated Metal Pipe - 0.024  
Concrete Lined Channel - 0.015  
Earth Channels - 0.030 to 0.050

DESIGN TABULATIONS

For systems of storm sewers with inlets in various locations, the time of concentration at any point will be time of concentration at the most remote inlet up street, plus the flow time in the storm sewer to the point under consideration. Computations for systems lend themselves readily to tabulation showing the drainage area, time of concentration runoff, and capacity of each inlet, and section of sewer under consideration. This data is to accompany the improvement plans

TABLE 1

STREET FLOW

Street flow shall be limited by pavement encroachment and depth of flow as follows:

Street Classification	*Maximum Encroachment of a two (2)-year storm
Local	No curb overtopping. Flow may spread to crown of street.
Collector	No curb overtopping. Flow may leave the equivalent of one 10-foot driving lane clear of water.
Arterials	No curb overtopping. Flow spread must leave the equivalent of two 10-foot driving lanes clear of water.

	One lane in each direction. *Where no curbing exists, encroachment shall not extend past property lines.
--	---

The storm sewer system shall commence at the point where the volume of flow equals five (5) cfs.

<u>Street Classification</u>	<u>Allowable Depth and Inundated Areas 100-year storm</u>
Local and Collector	Residential dwellings, public, commercial, and industrial buildings, shall not be inundated at the ground line. The depth of water over the gutter flowline shall not exceed 18 inches
Arterial	Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. Depth of water at the street crown shall not exceed six (6) inches to allow operation of emergency vehicles. The depth of water over the gutter flowline shall not exceed 18 inches.

CHAPTER VII - STORMWATER DETENTION REQUIREMENTS FOR PUBLIC AND  
PRIVATE IMPROVEMENTS

SECTION 100 - GENERAL

7-100        PURPOSE

7-100        Presented in this chapter are the minimum design and technical criteria for the analysis and design of stormwater detention facilities. Any subdivision, replatting, planned unit development, or any other proposed construction of additional impervious area submitted for approval shall include adequate storm drainage system analysis and appropriate detention design. Such detention analysis and design shall conform to the criteria set forth herein. The criteria will be revised or amended as new technology is developed and/or experience is gained in the use of these analysis and design requirements.

AUTHORITY

7-110        Chapter 36 Land Development Code, Article II Subdivision Regulations and Article IV Surface Water Runoff Division 3 addressing (detention and retention of stormwater) and Division 4 addressing (payment of funds in lieu of construction of detention facilities).

7-210        DETENTION REQUIREMENT

7-120.1     The primary purpose of a detention facility is to detain the excess or additional stormwater runoff associated with an increase in the impervious areas and the discharge of this excess at a rate no greater than the peak rate experienced from the basin prior to the additional development. Section 200 details the procedures for determining the detention volume, however, as a minimum, each site shall be analyzed to determine the peak flows using the Soil Conservation Service TR-55 tabular hydrograph method with a Type II storm distribution and a 24-hour storm duration for the 2-, 10-, 25-, and 100-year storm conditions. Detention volumes shall be determined by routing the resulting hydrograph through the detention basin using the Modified Puls Method as determined in Section 300.

7-120.2     Whenever the stormwater volume analysis submitted by the Engineer and approved by the Director of Public Works shows that detention has minimal effect on reducing downstream flooding, the developer may elect to buyout the detention volume

in lieu of constructing the stormwater detention facilities, subject to approval by the Director of Public Works.

#### CHECKLIST

7-130        A summary checklist for the project stormwater management plan is shown in Figure VII-A. This checklist is to be used in preparing the stormwater plan sheets.

### SECTION 200 - DETERMINATION OF PARAMETER VALUES

#### 7-200        SUMMARY METHODOLOGY

7-200.1     Peak discharge rates for the 2-, 10-, 25-, and 100-year storm events are determined for the proposed development using the SCS 24-hour storm with a Type II distribution, the SCS Curve Number method for separating abstractions, and the SCS Unit Hydrograph to determine peak flow rates. The detention volume and outlet structures are designed in such a manner that the post development peak flow rates are less than or equal to the predeveloped peak flow rates when the storm hydrograph is routed through the detention using the Modified Puls method.

7-200.2     In general, most sites can be analyzed using one outfall point and the SCS TR-55 tabular hydrograph mode. When the development is large in size, or complex, the most recent Flood Hydrograph Package by the Corps of Engineers may be required using the 24-hour SCS rainfall distribution. If other acceptable methods or deviations from these methods are approved for use, additional review time may be required.

7-200.3     The TR-55 methodology and procedures are presented in:

*Technical Release No. 55 (TR-55)*  
"Urban Hydrology for Small Watersheds,"  
Second Edition, June 1986;  
United States Department of Agriculture,  
Soil Conservation Service

The TR-55 procedures have also been incorporated in a computer program written in BASIC requiring less than 256K memory to operate. The program was developed for an MS-DOS operating system and can be obtained from:

National Technical Information Service  
U.S. Department of Commerce  
5285 Port Royal Road  
Springfield VA 22161

The following subsections present the input values and modified TR-55 procedures acceptable for detention basin design. Reference may be made directly to the June 1986 *Technical Release No. 55 (TR-55)* "Urban Hydrology for Small Watersheds."

#### 7-210 DETERMINATION OF WATERSHED AREA AND CURVE NUMBER, CN

7-210.1 In general, the outfall point is at the lowest point on the development next to a natural water course or public easement. Using this as the starting point, a watershed area is determined that encompasses the proposed development. (This may be larger than the proposed development due to offsite drainage flowing through the site.) The watershed is then transferred to the *Soil Survey of Greene and Lawrence Counties, Missouri Soil Maps prepared by the Soil Conservation Service*, and the extent of each soil type is determined. The Hydrologic Group for each soil type has been determined for the Springfield area and is shown in Figure VII-B - Hydrologic Values for various Soil Types. The Curve Number, CN, for each Hydrologic Group and associated land use for Springfield is shown in Figure VII-C - runoff Curve Numbers for Springfield.

7-210.2 The predeveloped CN is a composite area weighed curve number representing the historical land cover and uses. December 1975 topographic contour maps available in the Public Works Engineering Division shall be used to establish historical land cover and when site conditions have been altered without previously providing for detention.

7-210.3 The post development CN is a composite area weighed curve number for the entire watershed assuming full development as allowed by Zoning.

#### 7-220 DETERMINATION OF RUNOFF

7-220.1 Runoff in inches is determined by the SCS Runoff Curve Number method described in detail in the National Engineering Handbook Section 4 - Hydrology, SCS Washington, D.C. The various components required to compute this runoff are presented in the following subsections.

7-220.2 The **rainfall amounts** for the Springfield area (Table VII A - *Springfield 24-Hour Rainfall Totals*) were determined using the data published in Bulletin 71 (MCC Research Report 92-03) by the Midwestern Climate Analysis Center and Illinois State Water Survey.

Table VIIA - Springfield 24-Hour Rainfall Totals

Return Frequency (Annual Exceedance Probability)	Total Inches
2 yr (50%)	3.77
10 yr (10%)	5.55
25 yr (4%)	6.56
100 yr (1%)	8.18

7-220.3 The highest peak discharges from small watersheds is usually caused by intense, brief rainfalls that occur at distinct events or as part of a longer storm. **The rainfall distribution** chosen for Springfield's detention design is the synthetic 24-hour Type II rainfall distribution developed by the SCS as shown in Figure VII-D. The 24-hour storm, while longer than that needed to determine peaks for the drainage areas, is considered appropriate for determining runoff volumes.

7-220.4 **Initial abstraction** is all losses before runoff begins. It includes water retained in surface depressions, water interception by vegetation, evaporation, and infiltration. The initial abstraction coefficient to be used for Springfield is  $0.2S$ , where  $S$  is a function of the curve number.

#### 7-230 DETERMINATION OF TIME OF CONCENTRATION AND TRAVEL TIME

7-230.1 Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type flow that occurs is a function of the conveyance system and is best determined by observation of site conditions during storm conditions.

7-230.2 Sheet Flow is the flow over plane surfaces and is limited to flow depths of about 0.1 foot. When using the TR-55 method, the length of sheet flow is limited to 300 feet. The travel time for sheet flow is found using the Manning's

kinematic solution. The acceptable Manning's roughness coefficient "n-values," for sheet flow, are presented in Table VII-B

Table VII B - Roughness coefficients for **Sheet Flow**

Surface Description	n-value
Concrete, Asphalt, Gravel, etc.	0.05
Bare Soil	0.1
Poor grass cover	0.13
Dense grass cover	0.24
Bermuda Grass	0.41
Underbrush cover	0.4

7-230.3 Shallow concentrated flow usually occurs after sheet flow. The average velocity for shallow flow can be determined from Figure VII-E. For slopes less than 0.005-ft/ft use 0.005 slope values. The shallow flow component of the total travel time is then found by dividing the length by 3600 times the velocity. ( $T_t = L / 3600 \times V$ )

7-230.4 Open channels are assumed to begin when channels are visible on aerial photographs or on the ground, where blue lines appear on USGS quadrangle sheets, or where development has channelized the flow. Manning's velocity equation is to be used for bank-full conditions to determine the average flow velocity. Acceptable Manning's n-values for open-channel flow are presented in Figure VII-F

7-230.5 If the total travel times, or time of concentration ( $T_c$ ) is less than 0.10 hours use 0.10 hours. If  $T_c$  is greater than 2.0 hours, HEC-1 or other approved methods must be used

#### 7-240 DETERMINATION OF PEAK DISCHARGE

The peak discharge for each sub-basin and basin is determined using the tabular hydrograph procedure outlined in Chapter 5 of *Technical Release No., 55 (TR-55) "Urban Hydrology for Small Watersheds,"* dated June 1986. Various computer programs are available for use in determining the peak flow rate with a Personal Computer System.

## SECTION 300 - DETERMINATION OF STORAGE VOLUME FOR DETENTION BASINS

7-300.1 The determination of the required storage volume to attenuate the developed peak flow rates to the predeveloped peak flow rates is a function of the outlet structure and the storage routing curve of the basin.

7-300.2 The method used to route the inflow hydrograph through the outlet is the Modified Puls method. The Modified Puls method is an interactive process using the continuity equation such that the change in storage during the hydrograph time increment is equal to inflow minus the outflow to the reservoir during the same time increment. A detailed discussion of this method is found in ASCE Manual and Reports of Engineering Practice No. 77, *"Design and Construction of Urban Stormwater Management Systems,"* published by the American Society of Civil Engineers, 345 East 47<sup>th</sup> Street, New York, NY 10017, dated 1992.

### 7-310 TYPES OF OUTLET STRUCTURES PERMITTED

7-310.1 Outlet control structures are an important component of the detention facility since this structure controls both the rate of release from the basin and the water depth and storage volume in the basin. The structure also provides an obvious and effective outlet control for the detention basin. All control structures, as shown in Figure VII-G, should be an "H" structure with various controls to provide the required flow attenuation.

7-310.2 Control structures may include slotted weirs, orifices, rectangular weirs, or any combination of these structures necessary to control the release rate from the detention storage area. Plan view, sections, and the rating curve of the structure shall be included in the plans.

7-310.3 **Slotted weir.** When the slotted weir is used, the bottom shall have a minimum opening of four (4) inches. Figure VII-H shows a typical weir section with associated equation for determining flow in cubic feet per second for various weir designs.

7-310.4 **Orifice.** Orifice sections may not be smaller than four (4) inches in diameter to minimize maintenance and operating problems. When orifices are used to control the low flow, they shall be a minimum of six (6) inches in diameter and be provided with a bar screen on a minimum 2:1 slope to reduce blockage by debris. Figure VII-I shows a typical orifice

section with associated flow equation for computing flow in cubic feet per second for various head elevations.

7-310.5 **Rectangular weir.** The rectangular-shaped weir shall be used as the overflow weir. The total height of the control structure shall be one (1) foot higher than the 100-year water surface elevation. Figure VII-G shows a typical rectangular weir with associated flow equation for computing flow in cubic feet per second for various head elevations.

7-310.6 **Combined weir control.** The design of the control structure is calculated by taking individual components and combining their hydraulic functions to produce an integrated stage-discharge curve. For ease of hydraulic calculations it is assumed that the individual control elements will function independently, and the total discharge for each stage is the sum of the discharges for each control element at that stage.

7-310.7 The process is repeated adjusting either or both the detention volume and control weir section until the developed flow rates are equal to or less than the predeveloped flow rates for all storm events.

#### 7-320 DOWNSTREAM OUTLET CONTROL

7-320.1 The control structure shall discharge into a natural channel or improved drainageway. Assumption of sheet flow prior to leaving the property will not be permitted. If the capacity of the drainage way is exceeded, then topographic detail along with a profile of the centerline of the drainageway shall be provided from the control structure to the point of public access. The detail shall show all topography within 25 feet beyond the necessary width to adequately convey the 100-year peak discharge.

7-320.11 If the drainageway does not provide for public access then either:

a. A drainage easement through the private property to public right-of-way must be prepared and submitted to Public Works for approval before recording. The easement must totally contain the 100-year discharge, or

b. A signed and sealed certification from a registered Professional Engineer or Architect certifying that the detention outlet drains into a natural surface water channel with defined banks capable of receiving the stormwater flow without exceeding

the normal high water elevation. A sample letter that is acceptable for use is shown in Figure VII-J.

7-320.2 The discharge elevation of the outlet must be above the 100-year flood elevation of the receiving stream. It is assumed that there are no backwater effects to be accounted for. When the outlet discharges directly into a closed storm sewer system, it is the designer's responsibility to determine any backwater or submerged effects on the discharge

7-320.3 Whenever the discharge is into a natural grass channel, additional protection is required whenever the design discharge rate exceeds four (4) feet per second in the receiving channel. The additional protection may be grouted riprap, a concrete lining, or other engineered solution.

#### SECTION 400 - STORMWATER DETENTION PAYMENT IN LIEU OF CONSTRUCTION

7-400.1 Whenever the stormwater analysis presented by the developer and accepted by the Director of Public Works shows that detention provides no reduction in downstream flooding, the developer may apply for a buyout of the required detention volume. The actual dollar value is calculated at a rate of \$2 for each cubic foot for the first 24,000 cubic feet, \$1 for each cubic foot between 24,000 and 100,000, and \$0.50 for each cubic foot thereafter. The rate for one- and two-family developments is \$1 for each cubic foot for the first 24,000 cubic feet and \$0.50 per cubic foot thereafter. Whenever the stormwater analysis shows that detention will increase downstream flooding, the developer shall be required to pay to the City the above rate for the equivalent volume of detention required due to the increase in impervious area.

7-400.2 Buyout funds shall be used by the City to construct and maintain regional detention and conveyance systems within the drainage basin where the stormwater facilities would have been constructed. The two major drainage basins in the City of Springfield are the Sac River Basin and James River Basin.

7-400.3 Detention buyouts are not automatic and must be considered on a case-by-case basis by submission of the completed application shown in Figure VII-K. Initial determination of approval will be made by the Principal Civil Engineer. That decision may be appealed in writing to the Director of Public Works for a final determination.

7-400.4 When a buyout is approved, it is the responsibility of the developer to convey the stormwater runoff from the development to the existing storm sewer system by making whatever modifications are necessary to the existing system.

7-400.5 When the required detention volume is less than 5,000 cubic feet, the table shown in Figure VII-L may be used to determine the buyout amount.

#### SECTION 500 - STORMWATER AND DETENTION EASEMENTS

7-500.1 Three separate easements shall be provided for stormwater detention facilities on forms approved by the Department of Public Works. These easements are detention easement, access easement, and stormwater flowage easement.

7-500.2 All detention reservoirs with the exception of parking lots and roof detentions, shall be enclosed by an access easement. The limits of the easement shall extend a minimum of ten (10) feet beyond the maximum anticipated ponding area. The limits of the ponding area and legal description with the designation of the detention facilities shall be shown on the improvement plans and the final plat. This easement shall also be continuous with or to a public access area to allow the City to maintain the easement if necessary. If it is required that the City maintain the easement, the City shall have the right to change the party primarily responsible for maintenance as stated on the easement document.

7-500.3 A minimum 15-foot wide stormwater flowage easement shall be provided within the reservoir area connecting the tributary pipes and the discharge system along the most direct possible routing of a piping system for possible future elimination of the detention basin. The 100-year peak flow shall be contained within the limits of the drainage easement shown on the improvement plans and the final plat.

7-500.4 Easements not included as part of the final plat will have to be recorded on an easement form suitable for the type of development being proposed. The Right-of-Way Section of the Engineering Division of Public Works is the contact for obtaining these forms and assistance in completing said forms.

#### SECTION 600 - TEMPORARY DETENTION

7-600 It may be advantageous in some situations to delay the building of the permanent detention facilities until after the

completion of the other improvements. In these situations, temporary detention facilities must be provided. The permanent or temporary detention facilities shall be constructed and be functional before proceeding with any other construction.

#### SECTION 700 - OFF-SITE AND REGIONAL DETENTION CONCEPTS.

7-700.1 Off-site Detention. Stormwater detention facilities designed and constructed off-site or outside the limits of the proposed development will be considered for approval. This approval is contingent upon documentation being furnished to verify that drainage easements have been obtained from the proposed development to the detention facility in addition to easements for the detention area. The drainage easements must clearly set out provisions for maintenance.

7-700.2 Regional Detention. Detention facilities designed and located to provide for detention on major drainage channels will be considered a regional detention facility. The drainage area considered for a regional detention facility is generally several hundred acres. The regional basin must provide a detention volume for a 100-year storm for the entire drainage area. The regional detention facility must be designed with a low-flow, concrete channel through the limits of the basin. Upon conceptual approval of the location and final approval of the design and construction, the City of Springfield may accept the responsibility for the maintenance of a regional facility. Drainage and access easements will be required giving the City of Springfield the authority to gain vehicular access to the facility from a public street.

7-700.21 As additional development occurs upstream of the regional facility, on-site detention requirements may be bought out, provided the regional detention basin has been designed for full development of the basin, or if modifications are made to the regional facility by the developer to provide for the additional volume of detention required for the new development. Easements must be provided along the drainage channel from the new development to the regional facility, and the channel must be able to carry the peak rate of runoff from the 100-year storm from the entire basin upstream of the regional facility.

#### SECTION 800 - MAINTENANCE

7-800.1 Detention facilities are to be built in conjunction with the storm sewer installation and/or grading. Since these facilities are intended to control increased runoff, they must

be fully operational soon after the clearing of the vegetation. Silt and debris shall be removed periodically from the detention area and control structure in order to maintain full storage capacity.

7-800.2 The maintenance responsibility shall be vested in the owner of the basin or trustees of the subdivision by virtue of the trust indenture. The indenture of trust shall clearly indicate resident responsibility for maintenance.

7-800.3 The responsibility of maintenance of the detention facilities in single-lot development projects shall remain with the general contractor until final inspection of the development is performed and approved, and a legal occupancy permit is issued. After legal occupancy of the project, the maintenance of detention facilities shall be vested with the owner of the property.

7-800.4 If the trustees or owner fail to provide a reasonable degree of maintenance and the facilities become inoperative or ineffective, Springfield Public Works' crews may perform remedial work and assess the trustees or owner for the cost of repair and maintenance.

Figure VII-A. Storm Water Plan Review Checklist.

**PLAN REVIEW CHECKLIST FOR STORM WATER**

Date: _____ District/Section: _____
Subdivision: _____
Engineer: _____
File Number: _____ (Provided by Public Works)

**MUST BE FULLY COMPLETED BY THE ENGINEER**

**GENERAL INFORMATION**

Y	N	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Copy of the council-approved preliminary plat provided.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Two sets of drawings on 24" X 36" paper submitted.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Plans sealed, signed, and dated by Professional Engineer.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	City title block on all sheets.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Revisions noted.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Obtain MoDOT approval (if any work done in State ROW).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If development exceeds five (5) acres, a Land Disturbance Permit has been obtained from the Department of Natural Resources.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Obtained appropriate permit in Building Development Services Department to build or grade within a floodplain.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If property contains a sinkhole or drains to a sinkhole, submitted a sinkhole report in accordance with the sinkhole requirements of Chapter 36 of the Springfield City Code.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Stormwater plan conforming to City standards and generally accepted engineering procedures if not addressed in standards, including but not limited to:
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. Map showing drainage areas and design flows to each intake and conveyance structure in the immediate system.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. Capacity calculations of each intake and conveyance structure in the immediate system.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Map showing off-site drainage coming onto the site with calculations showing the effects on the design.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Note shown that bridges and culverts are designed for HS-20 loading.

## Title Sheet

Y	N	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Name of subdivision/improvement shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Name, address, and zip code of developer/owner shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Location sketch shown:
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. Scale shown
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. North arrow shown
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Two major streets shown
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Site Plan shown:
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. Subdivision legal description given
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. Elevation contours shown over the entire subdivision
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Lot lines and dimensions shown
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4. Two City benchmarks referenced
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5. North arrow shown
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6. Correct scale shown (1" = 40' or other appropriate)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Neighboring subdivision name and lot numbers shown if affected by construction.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Consultant's name, address, zip code, and phone number shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Selections of the storm sewer indexed by sheet number.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All applicable standard construction notes shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The "One Call" stamp and phone number shown

## PLAN AND PROFILE SHEETS

### Plan

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Scale shown (1" = 40' for undeveloped areas, 1" = 20' for developed areas).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	North arrows shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Line types defined (if not in standards).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Names shown of all landowners affected by project.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	New easements dimensioned and properly described.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Easements are sized to contain the developed 100-year flow.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A topographic survey of the property has been completed and contours with an interval no greater than two (2) feet are shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All other utilities are shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Gutter flows do not exceed 5 cfs for the 2-year storm.

## Profile

Y	N	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Existing and proposed ground profiles shown.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Note shown to compact sub-base to 95 percent of Standard Proctor if storm sewer is to be built on fill.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Profile extends beyond the improvements at both ends to clearly show how connection to existing system is to be made.

## OTHER COMMENTS

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Top of manhole elevations shown where sanitary sewer is within a drainage easement.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Channel linings determined based on design velocities.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Erosion control used at locations of high velocities (steep slope or culvert inlets and outlets, etc.)

## CERTIFICATION STATEMENT

I hereby certify I have checked the plans and review checklist for completeness, accuracy, compliance, and conformity with the plat, zoning and subdivision report, council bill, Public Works standards and specifications, and FEMA flood plain data. I further understand that review submittals without a signed checklist, without information required on the checklist, or without information or changes requested by a previous review may be returned to the Engineer without comment.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Registered Engineer of Record and Seal

Figure VII-B. Hydrologic Soil Group for Springfield Soils.

Soil Map Symbol	Soil Name	Hydro- logic Group
1B	Newtonia	B
2B	Pembroke	B
3D	Eldon	B
5C	Wilderness	C
6B	Creldon	C
9B	Needleye	C
10	Bado	D
11B	Sampsel	D
16B	Barco	B
21B	Peridge	B
23B	Bolivar	B
24	Parsons	D
26D	Collinsville	C
27D	Basehor	D
30C	Keeno	C
32C	Freeburg & Alsup	C
33B	Keeno & Eldon	C
35D	Clarksville & Nixa	B
40E	Alsup	C
43D	Goss	B
44E	Goss & Gasconade	B
45E	Clarksville	B
50C	Nixa	C
53B	Wilderness & Goss	C
54	Lanton	D
55	Huntington	B
56	Osage	D
61B	Hoberg	C
76	Hepler	D
81B	Viraton	C
83D	Gasconade – Rock Outcrop	D
94	Cedargap – Cherty	B
95	Cedargap – Silt Loam	B
240	Gerald	D
241B	Parsons & Sampsel	D
245	Carytown	D
921	Secesh & Cedargap	B
931	Waben & Cedar	B
940	Dumps – Orthents	C
941	Pits & Dumps	C
943	Orthents	C

Figure VII-C. Runoff Curve Numbers for Springfield.

<u>Cover Description and Hydrologic C</u>	Curve Numbers for Hydrologic Soil Group			
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Underdeveloped areas of brush-weed-grass mixture	35	48	65	73
Large Open Space (lawns, parks, cemeteries, etc.)				
Grass cover less than 50%	68	79	86	89
Grass cover 50% to 75%	49	69	79	84
Grass cover greater than 75%	39	61	74	80
Small Open Spaces – R/W, medians, islands, etc.	72	82	87	89
Grassed Detention Basin Area with trickle channel	68	79	86	89
Landscaped buffer strips	57	73	82	86
Newly graded or exposed earth	77	86	91	94
Impervious Areas:				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Newly constructed gravel surfaces	98	98	98	98
Gravel road	76	85	89	91
Curbed and Guttered Streets				
Residential – 50 ft. right-of-way	90	93	95	97
Collector – 60 ft. right-of-way	92	95	96	98
Developed areas including streets, parking, etc.				
Commercial and business	89	92	94	95
Industrial – average impervious 72%	81	88	91	93
Residential – average density 8 homes/ac.	77	85	90	92
Residential – average density 4 homes/ac.	61	75	83	87
Residential – average density 3 homes/ac.	57	72	81	86
Residential – average density 2 homes/ac.	54	70	80	85
Residential – average density 1 home/ac.	51	68	79	84
Residential – average density 1 home/2 ac.	46	65	77	82

Ref: Soil Conservation Service, 1986 "Urban Hydrology for Small Watershed,"  
Technical release 55, Washington, DC: U. S. Dept. of Agriculture.

# RAINFALL TABLE 2

## STANDARD SCS 24-HOUR, TYPE II DISTRIBUTION CUMULATIVE RAINFALL TABLE (REVISED MAY 1982)

Table No. 5  
Rainfall 2

Time Increment 0.2500

8	0.0	0.0020	0.0050	0.0080	0.0110
8	0.0140	0.0170	0.0200	0.0230	0.0260
8	0.0290	0.0320	0.0350	0.0380	0.0410
8	0.0440	0.0480	0.0520	0.0560	0.0600
8	0.0640	0.0680	0.0720	0.0760	0.0800
8	0.0850	0.0900	0.0950	0.1000	0.1050
8	0.1100	0.1150	0.1200	0.1260	0.1330
8	0.1400	0.1470	0.1550	0.1630	0.1720
8	0.1810	0.1910	0.2030	0.2180	0.2360
8	0.2570	0.2830	0.3870	0.6630	0.7070
8	0.7350	0.7580	0.7760	0.7910	0.8040
8	0.8150	0.8250	0.8340	0.8420	0.8490
8	0.8560	0.8630	0.8690	0.8750	0.8810
8	0.8870	0.8930	0.8980	0.9030	0.9080
8	0.9130	0.9180	0.9220	0.9260	0.9300
8	0.9340	0.9380	0.9420	0.9460	0.9500
8	0.9530	0.9560	0.9590	0.9620	0.9650
8	0.9680	0.9710	0.9740	0.9770	0.9800
8	0.9830	0.9860	0.9890	0.9920	0.9950
8	0.9980	1.0000	1.0000	1.0000	1.0000

9 end table

Note: On Executive Control use Rainfall Depth in inches and Rainfall Duration of 1.0.  
The format for this table is Form #271, Page F-7.

Figure VII-F. Manning's "n" values for Channel Flow.

<u>Type of Channel and Description</u>	<u>n-Value</u>
Natural winding channels	
No vegetation	0.025
Grass channel	0.030
Dense weeds in deep channel	0.035
Stony bottom and weedy banks	0.035
Cobble bottom with clean sides	0.040
Constructed uniform grass channels	
Earth, straight, uniform, and clean	0.022
Clean gravel bottom	0.025
Maintained grass channel	0.027
Non-maintained grass channel	0.035
Grass channel with concrete bottom	0.020
Concrete or asphalt channel	
Smooth or float finish	0.013
Unfinished concrete	0.017
Gunitite	0.200
Riprap lined channels	
Ordinary riprap	0.060
Gabions	0.035
Grouted riprap	0.027
Slope mattress	0.028

Figure VII-J. Sample Letter to Downstream Property Owner.

## SAMPLE LETTER

Date

(Property Owner)  
(Address)

Re: Certification of a Downstream Surface Water Channel

Dear (Property Owner):

Please be informed that I have certified a portion of your property as a natural surface water channel for the purpose of discharging stormwater runoff from the proposed (name of development) at (address of development). The additional runoff created by the development will not cause the capacity of the downstream channel to be exceeded.

Sincerely,

(name of professional engineer/architect of record)  
(name of engineering/architectural firm)

Certified copy: City of Springfield, Department of Public Works

Professional  
Seal

Figure VII-K. Application for Payment in Lieu of Constructing Stormwater Detention.

CITY of  
SPRINGFIELD



## APPLICATION FOR PAYMENT IN LIEU OF CONSTRUCTING STORMWATER DETENTION

---

### Section 1. GENERAL INFORMATION

---

APPLICANT: \_\_\_\_\_ DATE: \_\_\_\_\_

DEVELOPMENT: \_\_\_\_\_

LOCATION: \_\_\_\_\_  
(Address, Block #, 1/4 1/4 Section, Township, Range)

---

### Section 2. DETENTION VOLUME DETERMINATION

---

Detention volume has been determined in accordance with the detention ordinance (check one).

- ☐ The required detention volume has been determined using the table in the detention ordinance. The use of this table is acceptable only for volumes below 5,000 c.f. Calculations, maps, etc., used to determine the required volume are being submitted with this application.

The required volume is \_\_\_\_\_ c.f.

- ☐ The required detention volume has been calculated by either SCS or Corps of Engineers methods and all supporting information including maps, detailed calculations, and computer input and output are being submitted with this application.

The required volume is \_\_\_\_\_ c.f.

---

### Section 3. DOWNSTREAM IMPACT ANALYSIS

---

A Downstream Impact Analysis is necessary to show that detention for this development provides no downstream benefit. The analysis must extend downstream from the development to a point where the "10 Percent Rule" holds true. (The point where the area of the development is less than 10 percent of the total contributing drainage area.)

- ☐ All calculations, maps, etc., are being provided with this application to determine the location downstream of the site where the "10 Percent Rule" holds true.

If the “10 Percent Rule” holds true at the point runoff leaves the site, no further off-site analysis is necessary. The “*No Downstream Impact Certification Statement*” below must be signed and sealed.

Special Note Regarding Sinkholes: Based on the City Sinkhole Ordinance, any development within a sinkhole drainage area requires a study of the effects on sinkhole flooding. See the Sinkhole Ordinance for required calculations. The “10 Percent Rule” does not waive the requirements of the Sinkhole Ordinance.

If the “10 Percent Rule” does not hold true at the discharge point from the property, the downstream location where the “10 Percent Rule” does hold true must be determined to establish the limits of the required analysis. The following information must be submitted with this application:

- ☐ A map showing the proposed development, the total contributing drainage and all conveyance facilities within the limits of the analysis. Provide a complete inventory of all structures and distinct channel reaches within the limits of the analysis. Show at each structure and distinct reach the design flow and hydraulic capacity of the existing facilities. Provide information about known or determined flooding problems that exist within the limits of the analysis with an emphasis on flooding of buildings, streets, and yards.

If it is found that either the “10 Percent Rule” holds true at the discharge point from the property or if it is found that all downstream facilities within the limits of the analysis meet or exceed City standards under post-developed conditions, then the following statement must be signed and sealed:

*No Downstream Impact Certification Statement*

---

As the professional engineer or architect of record, I certify that, based on my analysis using standard engineering practices, stormwater detention for this development will not provide any downstream benefits and the development will not increase downstream flooding.

\_\_\_\_\_  
Professional Engineer or Architect

---

The primary City standards for stormwater improvements are as follows:

1. Culverts, pipes, and ditches draining more than 1 square mile must be designed for the 100-year storm.
2. Culverts, pipes, and ditches draining 1 square mile or less must be designed for the 25-year storm.
3. The storm sewer must commence in a street at the point where the 2-year storm is 5 cfs.
4. The maximum depth in a local street for a 2-year storm is 6 inches.

5. The maximum depth in a collector street for a 2-year storm is 6 inches with one 10-foot clear lane.
6. The maximum depth in an arterial street for a 2-year storm is 6 inches with two 10-foot clear lanes.
7. The maximum depth in an arterial street for a 100-year storm is 6 inches over the crown or 18 inches over the flowline of the gutter.
8. The maximum depth in a non-arterial street for a 100-year storm is 18 inches over the flowline of the gutter.
9. Where streets have no curbs, water encroachment shall not exceed past property lines.
10. No buildings may be inundated at the ground line for the 100-year storm.

Complete City standards for stormwater improvements may be found in "Design Standards for Public Improvements."

If it is found through the Downstream Analysis that the conveyance facilities do not meet City standards, one or both of the following conditions will exist. **(Following the condition is the required response in bold print):**

- ☐ Facilities with the limits of the analysis meet or exceed City design standards under existing conditions but increased design flows will exceed the capacity of the facilities under post-development conditions. **The capacity of the facilities must be increased so that the capacity of the new facilities meets or exceeds the increased design flows.**
- ☐ Facilities within the limits of the analysis do not meet City design standards under existing conditions and design flows to these facilities will be increased under post-development conditions. **The capacity of the facilities must be increased by the amount of the increase in design flows.**

Once the downstream improvements have been designed based on the above requirements, the following statement must be signed and sealed:

*No Downstream Impact With Improvements Certification Statement*

As the professional engineer or architect of record, I certify that, based on my analysis using standard engineering practices, with the proposed downstream stormwater improvements, the development will not increase downstream flooding.

\_\_\_\_\_  
Professional Engineer or Architect

Note: It is required that, when possible, additional runoff from developments flow to a public right-of-way or drainage easement. When neither of these is available, it is required that the professional engineer or architect of record certify that the discharge is to a natural channel and will not exceed the capacity of that channel. This statement

must be placed on the plans at the point of discharge and a letter from the engineer or architect of record must be sent certified mail to all downstream property owners within the limits of the analysis certifying a portion of their land is a natural channel. A copy of the letter of certification and the mail receipts must be submitted to the Public Works Engineering Division. A sample letter containing the minimum necessary information is attached to this application.

---

#### **Section 4. AMOUNT OF PAYMENT**

---

The rate structure used to determine the amount of the payment is based on the proposed land use. The two categories are (check one):

- ☐ One or two family residential
- ☐ Other land uses

#### Table of Payment Rates

---

Table of Payment Rates		
<u>Volume of Detention</u>	<u>one or two family residential</u>	<u>other land uses</u>
0-24,000 c.f.	\$1 per c.f.	\$2 per c.f.
24,000-100,000 c.f.	\$0.50 per c.f.	\$1 per c.f.
>100,000 c.f.	\$0.50 per c.f.	\$0.50 per c.f.

---

- ☐ Amount: \$\_\_\_\_\_

---

#### **Section 5. THIS SECTION IS FOR CITY USE ONLY**

---

Payment in lieu of detention without downstream improvements

- ☐ Detention volume determination is acceptable.
- ☐ The approved payment amount is \$\_\_\_\_\_.
- ☐ The downstream impact analysis is acceptable.
- ☐ The application for payment in lieu of detention is DENIED.

---

---

Approval of this payment in lieu of detention is recommended.

---

Stormwater Plan Reviewer

---

---

Payment in lieu of detention with downstream improvements

- ☐ Detention volume determination is acceptable.
  - ☐ The approved payment amount is \$\_\_\_\_\_.
  - ☐ The downstream impact analysis is acceptable.
  - ☐ The downstream stormwater improvement plans are acceptable. File No. \_\_\_\_\_.
  - ☐ The cost of downstream improvements is \$\_\_\_\_\_.
  - ☐ The payment due is \$\_\_\_\_\_.
  - ☐ The application for payment in lieu of detention with downstream improvements is DENIED.
- 
- 

Approval of this payment in lieu of detention with the downstream improvements is recommended.

---

Stormwater Plan Reviewer

---

---

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

---

---

Approval of payment in lieu of detention

---

Principal Civil Engineer

---

---

CUBIC FEET OF DETENTION REQUIRED  
% IMPROVED

A C R E S  D E V E L O P E D		20	30	40	50	60	70	80	90	100
	0.10	250	390	500	640	765	900	1,020	1,150	1,280
	0.20	500	765	1,020	1,275	1,530	1,800	2,040	2,300	2,550
	0.30	765	1,150	1,530	1,920	2,300	2,680	3,060	3,450	3,830
	0.40	1,020	1,530	2,040	2,550	3,060	3,570	4,080	4,600	
	0.50	1,280	1,910	2,550	3,200	3,830	4,460			
	0.60	1,530	2,300	3,060	3,830	4,600				
	0.70	1,800	2,680	3,570	4,460					
	0.80	2,040	3,060	4,080						
	0.90	2,300	3,450	4,590						
	1.00	2,550	3,830							
	1.25	3,190	4,780							
	1.50	3,830								
	1.75	4,470								

- Notes:
1. Detention may be bought out if no immediate flooding exists.
  2. If detention was previously bought out and this buy out together with the previous buy out is larger than the allowed then all the detention must be constructed with no refund.

Figure VII-L. Detention Volume Table for Basins < 5,000 Cubic Feet.

## Chapter VIII - STREETS, ALLEYS, CUL-DE-SACS AND INTERSECTIONS

### A. STREETS

1. Street Construction. City streets shall be constructed of Portland Cement Concrete with integral curb (or concrete curb and gutter) or bitumious plant mix roadway with a concrete curb and gutter. Alley pavement shall be of either asphalt or concrete design, with an inverted crown and the curb omitted. Asphaltic streets will require bitumious or "full depth" asphalt base.
2. Roadway Sections. Typical roadway sections showing various widths of roadway and right-of-way and required thickness are as shown on Standard Drawing ST-1 included in these design standards. Primary arterials and expressways are not included in these design standards since such projects require individual study.
3. Street Design. In the preparation of street design, the following criteria must be observed. These controls are intended to be the absolute minimum (or maximum) permitted. Where two of the controls, a through e, are used concurrently in a street segment, the remaining controls, a through e, cannot be the minimum (or maximum) value. Any design not meeting this requirement must have prior approval. Road classification greater than those listed will require a special design to meet current AASHTO Standards.

a.	Grades	- minimum	0.5% All Systems
		- maximum	Second arterial
	5%		
		Collector	8%
		(Residential and Non Residential)	
		Local	10%
		(Residential and Non Residential)	
		Alleys	10%

- b. Vertical Curves. The length of vertical curves shall be no less than that determined by the formula

$L = KA$ , where:

$L$  = Length of vertical curve

$A$  = Algebraic difference in grades

$K$  = Determined by following table:

Table of "K" Values

	<u>Crest</u>	<u>Sag</u>
Secondary Arterial	80	70
Collector		
Non-Residential	60	60
Collector		
Residential	40	50
Local		
Non-Residential	30	40
Local		
Residential	20	30
Alleys	10	20

- c. Minimum centerline radii (R) and Maximum superelevation (E)

Secondary Arterial	$R = 600'$	$E = 0.04$
Collector (Residential and		
Non-Residential)	$R = 400'$	$E = 0.03$
Local		
Non-Residential	$R = 300'$	$E = 0.02$
Local		
Residential	$R = 175'$	$E = 0.02$
Alleys	$R = 175'$	Inverted
		6" Crown
Minimum length of superelevation runout = 100'		

d. Minimum curb radii at intersections:

	<u>Intersecting</u> <u>Res. Local and</u> <u>Res. Collector</u>	<u>Street</u> <u>Non-Res. Local</u> <u>and Collector</u>
Secondary Arterial	30'	50'
Collector		
Residential	15'	20'
Collector		
Non-residential	20'	30'
Local		
Residential	15'	20'
Non-Residential	20'	30'

e. Minimum Safe Stopping Sight Distance

Secondary Arterial	325'
Collector	
Non-Residential	250'
Collector	
Residential	200'
Local	
Non-Residential	200'
Local	
Residential	150'

f. Minimum Safe Stopping Distance at Intersections

Secondary Arterial	500'
Collector	
Non-Residential	450'
Collector	
Residential	400
Local	
Non-Residential	300'
Local	
Residential	250'

g. Intersections. All curb returns shall be designed with a wheel chair ramp meeting the requirements of Standard Drawing ST-13 included in these design standards. No drainage structures shall be allowed in the wheelchair path. Intersections shall be approached on all sides by leveling areas. Where the approach grade for either or both streets exceed 3

percent, the leveling area shall be a minimum length of 100 feet measured from the intersection of the edge of gutter flag or edge of road, within which no grade shall exceed a maximum of 3 percent with a maximum crossfall of 6" at the throat of the radius returns of the intersecting street. Right angle intersections shall be used whenever practicable. When local streets intersect collector or arterial streets, the angle of intersection of the street centerlines shall not be less than 75°. A diagonal sight distance easement must be provided (as shown on sheets VIII-6 and VIII-7) on the property lines substantially parallel to the chord of the curb radius.

Elevations at street intersections shall be computed by extending curb grades to the P.I. of the intersection of curbs. A minimum of 0.3 feet fall around a curb return is required. Elevations at every 10 feet around the curb return and centerline stationing at all radius points shall be shown on the plan.

All pavement stationing shall be shown using face of curb data.

h. Plan. The following information shall be shown on the plan portion of each plan sheet:

- (1) Width of right-of-way.
- (2) Width of pavement (back-to-back of curbs).
- (3) Curb and right of way radii with elevation and stationing.
- (4) Location and size of existing utilities, meters, valves, poles, street markers, signs, traffic signals, trees, shrubs, drainage ditches, structures, storm sewers, easements, sanitary sewers and manholes. The proposed location of any of the above must also be shown. Central angle, centerline radius, arc length, and tangent distance of horizontal curves. Stationing of beginning and end of paving, PC and PT stationing of curves and ties to lot corners. All lot dimensions.

- i. Profile. The following information shall be shown on the profile portion of each plan sheet:
  - (1) Existing ground lines at both right of way lines with elevations shown at 50' intervals.
  - (2) Proposed top of curb grades for both curbs.
  - (3) Centerline elevation and stationing at areas where typical cross sections are not applicable.
  - (4) Top of curb elevations and stationing at beginning and end of paving, beginning, end, and P.I. of vertical curves, and mid-ordinate of vertical curves.
  - (5) Elevation and station of low point of sags.
  - (6) Top of curb shall be noted.
- j. Typical Section. A typical section shall be shown on the first plan sheet indicating:
  - (1) Pavement type, width, and thickness
  - (2) Crown
  - (3) Curbs
  - (4) Parkway width
  - (5) Right of way width
  - (6) Sidewalks
- k. Cul-de-sacs. Information needed on cul-de-sacs is shown on Standard Drawing ST-5, included in these design standards.
- l. Expansion Joints. Expansion joints in concrete paving shall be placed as shown on standard drawings at intersections unless otherwise shown on plans and at all structures crossing the roadway such as bridges, box culverts, etc.

Expansion joints are required around junction boxes, inlets, etc.

- m. Contraction Joints. Contraction joints in concrete paving shall be placed as shown on standard drawings at intervals of not more than 25 feet and not more than 25 feet from any expansion joint. Contraction joints shall be without dowels unless otherwise specified on plans.
- n. Longitudinal Joints. Longitudinal joints shall be placed as shown on the Standard Drawings included in these design standards.
- o. Manholes. Manhole designation and elevation of top of manhole must be given when located within right-of-way.
- p. Storm Sewers. Flow line elevations must be given for storm sewers within right-of-way.
- q. Approaches to existing streets. All approaches to existing curb and gutter streets shall be Portland Cement Concrete to the radius points.

# STREET STANDARDS CITY OF SPRINGFIELD

	COLLECTOR STREETS		LOCAL STREETS		
	Normal	Residential	Commercial/ Industrial	Residential	Marginal Access
Characteristics	<ul style="list-style-type: none"> <li>—Major thoroughfare plan</li> <li>—Connects between arterial streets</li> <li>—Serves multiple land uses</li> </ul>	<ul style="list-style-type: none"> <li>—Connects Residential Local Streets to Arterial Streets</li> </ul>	<ul style="list-style-type: none"> <li>—Access to industrial/commercial properties</li> </ul>	<ul style="list-style-type: none"> <li>—Access to residential properties</li> </ul>	<ul style="list-style-type: none"> <li>—Access to residential properties</li> <li>—Less than 40 dwelling units</li> <li>—Adjacent to arterial right-of-way</li> </ul>
Right-of-Way Width	60	50	60	50	40
Parking	None	None	One Side	One Side	One Side
Maximum Grade (%)	6%	6%	6%	10%	10%
Minimum Grade (%)	0.5%	0.5%	0.5%	0.5%	0.5%
Pavement Width (Back-to-Back)	37'	29'	37'	27'	21'

## STREET RIGHT-OF-WAY AND CONSTRUCTION REQUIREMENTS

	Expressway	Major Arterial	Secondary Arterial	Collector	Residential Collector	Non-Res. Local	Normal Res. Local	Marginal Access
Right of way – Normal (Feet) at Intersection	130'	100'	70'	60'	50'	60'	50'	40' & 10E'
	---	---	80'	65'	60'	---	---	---
Pavement Width – Normal (Feet) at Intersection	76'	69'	43'	37'	29'	37'	27'	21'
	101'	81'	55'	43'*	37'	---	---	---
Sidewalk Requirements	As Needed	Both Sides	Both Sides	Both Sides	Both Sides	One Side	One Side	One Side
Minimum Centerline Radius	To Be Designed	To Be Designed	600'	400'	300'	300'	175'	175'
Parking Prohibitions	Both Sides	Both Sides	Both Sides	Both Sides	Both Sides	Both Sides	As Needed	One Side

\* Widening flared to the leaving side of opposite approaches

## RIGHT-OF-WAY TRIANGLE REQUIREMENTS

Intersection of With	Expressway	Major Arterial	Secondary Arterial	Non-Res. Collector	Residential Collector	Non- Residential Local	Residential Local	Marginal Access
Expressway	A	A	A	B	B	B	B	B
Major Arterial	A	A	A	B	B	B	C	C
Secondary Arterial	A	A	B	B	C	C	D	D
Collector	B	B	B	C	C	C	D	D
Residential Collector	B	B	C	C	C	C	D	E
Non-Res. Local	B	B	C	C	C	C	D	E
Residential	B	C	D	D	D	D	E	E
Marginal Access	B	C	D	D	E	E	E	E

### KEY:

- A – 100' X 100' ROW triangle w/separate right turn lanes
- B – 30' X 30' ROW triangle w/50' corner radii
- C – 10' X 10' ROW triangle w/30' corner radii (or 15' ROW radius)
- D – 10' X 10' ROW triangle w/20' corner radii (or 15' ROW radius)
- E – No ROW triangle w/15' corner radii

## Design Standards for Public Improvements

### CHAPTER X - SIDEWALKS, CURB AND GUTTER, AND DRIVEWAYS

#### A. SIDEWALKS

1. General. Sidewalks are required in subdivisions on at least one side of residential streets and on both sides of collector and arterial streets. All new constructed walks shall meet the requirements of the 1990 Americans with Disabilities Act as published in the Federal Register Vol. 156, No. 144/Friday, July 26, 1992, pages 35459 through 35511.
2. Design. Sidewalks are constructed from Class "A" Portland cement concrete, 4 inches thick, except where 6-inch thickness is required in residential driveways, and 8-inch reinforced thickness is required in commercial driveways and 18 inches on either side of said area. The sidewalk shall be constructed such that panels are formed using control joints that shall extend to  $\frac{1}{4}$  the depth of the sidewalk. If a grooving tool is used to form the control joint, the groove shall not be wider than  $\frac{1}{4}$ " and edged with a  $\frac{1}{8}$ " radius. If the control joints are sawed, the groove shall not be less than  $\frac{1}{8}$ " wide. Whichever method of grooving is used the control joints are to be cut such that the resulting panel lengths are not less than 4 feet nor greater than 6 feet. Edges of the slab shall be edged with an edging tool that has a  $\frac{1}{4}$ " radius.

A sidewalk plan must be prepared to show the sidewalk in plan, profile, and typical cross section. This plan may be included as part of the street plan. For sidewalks to be constructed on unimproved streets, it is necessary to obtain sufficient field data to determine the probable future grade of the street curb and design the sidewalk accordingly. Additional right-of-way may have to be provided.

3. Location. The outside edge of the sidewalk shall be placed 1 foot inside the street right-of-way line.
4. Width. Residential sidewalks shall be a minimum width of 4 feet.

5. Expansion Joints. Bituminous preformed expansion joints,  $\frac{1}{2}$ " thick and precut to the width of the sidewalk, shall be indicated on the plans 18" on each side of driveways, intersecting walks, curbs, and other locations as required.

Expansion joints shall be placed at the locations specified on the plans or standard drawings. Expansion joints shall be placed between the sidewalk and all structures, such as light standards, traffic light standards, traffic poles, and columns, etc., which extend through the sidewalk.

6. Ramps.

General. All ramps shall be constructed to the least possible slope with a maximum allowable slope of 1:12 (8.33%). The maximum rise for any run shall be 30 inches. A level landing area of  $\frac{1}{4}$ "/ft. (2%) cross slope or less shall be constructed at the top and bottom of each ramp or ramp run. The minimum length of landing areas are to be 60". The minimum width of a ramp shall be 48 inches, exclusive of flared sides.

If a ramp is located where pedestrians must walk across the ramp, or where it is not protected by handrails or guardrails, it shall have flared sides with a maximum slope of 1:12 (8.33%). Curb ramps with returned curbs may be used where pedestrians would not normally walk across the ramp.

No ramp shall be permitted to project beyond the curb into vehicular traffic. Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

All ramped surfaces shall be constructed using colored concrete to provide a visually contrasting surface as per paragraph 4.29.2 of the Americans with Disabilities Act of 1990. This color shall be either Solomon Grind-Chem Service Color #417 - Red, (or equivalent red coloration), with 4½# of pigment per 94 lb. of Portland cement for truck or plant mixed full depth colored concrete, or (1) 60# bag of dry shake per 100 S.F. with a minimum thickness of  $\frac{1}{4}$ " for surface treated areas. Base concrete is to be mag

floated and be free of surface water before application.

All ramps shall have a detectable warning comprised of tooled grooves spaced 6" apart, constructed perpendicular to direction of travel. Grooves are to be constructed to same specifications as tooled control joints.

Curb ramps shall be provided at all street intersections, at any marked midblock crossing, and any curbed transitions. Transitions from ramps to walks, gutters, or streets shall be flush and free of abrupt changes (1/4" or greater change in elevation).

Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides. If diagonal (or corner type) curb ramps have returned curbs or other well-defined edges, such edges shall be parallel to the direction of pedestrian flow. The bottom diagonal curb ramps shall have 48 inches minimum clear space.

If diagonal curb ramps are provided at marked crossings, the 48 inches clear space shall be within the markings. If diagonal curb ramps have flared sides, they shall also have at least a 24-inch long segment of straight curb located on each side of the curb ramp and within the marked crossing.

Any raised islands in crossings shall be cut through level with the street or have curb ramps at both sides and a level area at least 48 inches long between the curb ramps in the part of the island intersected by the crossings.

7. DESIGN CHECKLIST FOR SIDEWALKS.

\_\_\_\_\_ Sidewalks shown in plan and profile on at least one side of residential streets and on both sides of collector and arterial streets.

\_\_\_\_\_ On unimproved streets sufficient field data is shown to determine probable future grade of street curb and sidewalk designed accordingly.

\_\_\_\_\_ Typical cross sections shown with plan and profile.

\_\_\_\_\_ Outside edge of sidewalk is placed 1 foot inside of right-of-way line.

\_\_\_\_\_  $\frac{3}{4}$ " expansion joints are indicated on the plans.

\_\_\_\_\_ Sidewalk minimum width - 48" minimum thickness of 4" (or 6" when sidewalk crosses a residential driveway or 8" reinforced when sidewalk crosses a commercial driveway or alleys).

\_\_\_\_\_ Sidewalk cross slope not greater than  $\frac{1}{4}$ /ft. or 1:50 (2%).

\_\_\_\_\_ All ramp slopes that are greater than 1:12.

\_\_\_\_\_ Maximum rise for any length of run is 30".

\_\_\_\_\_ Level landing areas provided at top and bottom of each run.

\_\_\_\_\_ Detectable warning system indicated on all ramp surfaces.

\_\_\_\_\_ Curb ramps provided wherever sidewalk crosses a curb.

\_\_\_\_\_ Minimum width of curb ramp - 48".

\_\_\_\_\_ Accessible crossing area indicated on any raised island crossing.

## B. CURB AND GUTTER

1. General. Curb and gutter are required on all public improvement street projects.
2. Design. Curb and gutter are to be constructed from Class "A" Portland cement concrete. The width of the curb and gutter is to be 2 feet 6 inches. The curb height is to be 6 inches, and the gutter cross slope is to be 2 inches in 2 feet. The thickness of the gutter shall be 6 inches for residential streets and 8 inches for collector streets. The street plan shall

show the top of curb elevation in the profile. At driveway locations shown on the plans, the gutter is to be carried across the drive while the curb is depressed to match the driveway slope. If driveway locations are now shown on the plans, curbs cannot be depressed.

3. Expansion Joints. Bituminous preformed expansion joints,  $\frac{3}{4}$  inch thick and precut to the exact cross section of the curb and gutter shall be placed at all driveway and intersection radii and at intervals of not more than 200 feet.

4. DESIGN CHECKLIST FOR CURB AND GUTTER

\_\_\_\_\_ Curb and gutter provided for on all improved streets.

\_\_\_\_\_ Street profile shows top of left and right curb elevations.

\_\_\_\_\_ Curb cross section shows curb height - 6" and width - 2' 6".

\_\_\_\_\_ Gutter thickness 6" local residential streets.

\_\_\_\_\_ Gutter thickness 8" non-residential local streets and collector residential streets.

\_\_\_\_\_ Curb height 6 inches.

\_\_\_\_\_ Curb and gutter width 2 feet 6 inches.

\_\_\_\_\_ Gutter cross slope is 1"/ft (except at ramp areas).

\_\_\_\_\_ Curb depressed to match driveway slopes.

\_\_\_\_\_  $\frac{3}{4}$ " expansion joints indicated placed at all driveways and at intervals of not more than 200 feet.

## C. DRIVEWAYS

1. General. Driveway approaches are located to serve the operation of automobiles and other vehicles from the street pavement to a garage, parking area, building entrance, structure, or other approved use located on the property.
2. Design. Residential driveway approaches shall be constructed using 6" thick Class "A" concrete. All driveway pavement shall be poured over 4" thick compacted Type I aggregate base. When a driveway approach intersects an existing 4-inch thick sidewalk, the area of the sidewalk within the driveway area including both sides of the sidewalk transition sections to meet the drive elevation or 18 inches, whichever is greater, shall be removed and reconstructed with 6-inch thick concrete. The cross slope of the sidewalk area is not to exceed  $\frac{1}{4}$ "/ft. or 1:50 (2%). The grade of the driveway approach from the gutter line shall rise on a constant grade to the front edge (street side) of the sidewalk area. The slope of the driveway approach shall be at least 1:48 ( $\frac{1}{4}$ "/ft.) and not to exceed 1:8 ( $1\frac{1}{2}$ "/ft.).

Commercial/non-residential driveway approaches shall be constructed using 8" thick reinforced Class A Portland Cement Concrete. All driveway pavement shall be poured over 4" thick compacted Type I aggregate base. Reinforced concrete shall be either fibermesh or #4 rebar 18" O.C. When a driveway approach intersects an existing 4-inch thick sidewalk, the area of the sidewalk within the driveway area, including both sides of the sidewalk transition sections to meet the drive elevation or 18 inches, whichever is greater, shall be removed and reconstructed with 8-inch reinforced thick concrete. The cross slope of the sidewalk area is not to exceed  $\frac{1}{4}$ "/ft. or 1:50 (2%). The grade of the driveway approach from the gutter line shall rise on a constant grade to the front edge (street side) of the sidewalk area. The slope of the driveway approach shall be at least 1:48 ( $\frac{1}{4}$ "/ft.) and not to exceed grade dimension shown on ST-14.

No driveway approach shall be permitted which will interfere with any existing parking meters, signs,

traffic control devices, plantings, cables, poles, guys, water mains, gas mains, or other public utilities. No part of any driveway approach may be located within 4 feet of a drop inlet or other drainage structure nor a pedestrian ramp.

No part of any driveway approach shall be located within 40 feet of a point on the right-of-way opposite the end of a raised median.

Joint driveway approaches shall be permitted only if there is a perpetual mutual access agreement approved by the City Attorney and filed of record in the Greene County Recorder's Office.

The width of residential driveway approaches shall not exceed 22 feet without permission from City Traffic Engineer and shall not be less than 12 feet for new construction, and not less than the existing approach for reconstruction.

All driveway approaches shall be located to provide the following minimum clearances: Nearest edge of the driveway to nearest right-of-way line of alleys, 10 feet; nearest edge of the driveway to property line, 5 feet; on corner lots, nearest edge of the driveway to nearest right-of-way line of an intersecting street, 20 feet, but in no case shall the driveway return extend closer than 15 feet to the intersection right-of-way line extended. Where sight distance triangles exist, the nearest edge of the driveway to nearest corner of triangle shall be at least 20 feet.

The edges of driveway approaches may be skewed so that the angle between the street right-of-way line and the edge of the driveway approach is not less than 60 degrees.

The radius of the driveway approach shall not, in any case, extend beyond the projection of the adjacent property line, extended perpendicularly to the right-of-way line.

The maximum radius of a driveway return shall not exceed the distance between the edge of the roadway and the right-of-way line, or 15 feet, whichever is smaller.

3. Expansion Joints ½"

4. Sawcutting and Gutter

The curb and gutter section in front of a driveway (radius point to radius point) shall be sawcut full depth and removed before the driveway is poured. The entire curb and gutter section would then be replaced with Class A concrete with the depth equal to that of the adjacent approach. Any curb and gutter broken or cracked outside the radius points during this removal shall also be removed and replaced accordingly.

Any damage to the existing street shall be the responsibility of the contractor or replace as per the General Conditions Technical Specifications for Public Improvements.

5. DESIGN CHECKLIST FOR DRIVEWAYS

\_\_\_\_\_ Driveway locations indicated on plans.

\_\_\_\_\_ Driveway approach not within 40 feet of a point on the right-of-way line opposite the end of a raised median.

\_\_\_\_\_ Driveway approaches do not interfere with any existing parking meters, signs, traffic control devices, plantings, cables, poles, guys, water mains, gas mains, or other public utilities.

\_\_\_\_\_ Copy of approved joint driveway approach agreement filed in the Greene County Recorder's Office.

\_\_\_\_\_ Width of driveway approach at right-of-way line is not less than 12 feet nor more than 22 feet.

\_\_\_\_\_ Minimum driveway approach clearances:

\_\_\_\_\_ Approach not within 4 feet of a drop inlet or other drainage structure or pedestrian ramp.

\_\_\_\_\_ Nearest right-of-way of alley - 10 feet.

\_\_\_\_\_ Nearest edge to property line - 5 feet.

\_\_\_\_\_ If corner lot, nearest edge to nearest  
right-of-way of intersecting street - 20 feet.

\_\_\_\_\_ Nearest corner of sight triangle - 20 feet.

\_\_\_\_\_ Approach skewed to not less than 60 degrees  
between street right-of-way line and the edge of the  
driveway approach.

\_\_\_\_\_ Radius of driveway approach not extended  
beyond the projection of the adjacent property line.

\_\_\_\_\_ Radius of driveway return is designed for  
the classification of street and type of vehicle use.

\_\_\_\_\_ Expansion joints indicated.

\_\_\_\_\_ Cross slope of sidewalk area within the  
driveway must not exceed 3/16"/ft. or 1:50 (2%).

## CHAPTER XI - MISCELLANEOUS

### A. TRAFFIC SIGNALS

Traffic signal installations are normally designed by the City Traffic Engineer. Prior written approval must be obtained from the City Traffic Engineer by private consultants wishing to design Public Traffic Signal Installations.

### B. PARKING STALL REQUIREMENTS

Minimum requirements for parking stalls are shown on Standard Drawing ST-6 included in Chapter XII of these design standards.

### C. RIPRAP

All locations where riprap is required must be shown on the plans. Riprap parameters must be shown and all riprap shall meet the requirements of the latest revision of the City of Springfield Standard General Conditions and Technical Specification for Public Works Construction.

### D. STREET TREE PLANTING - PUBLIC IMPROVEMENTS

Whenever a public funded street improvement is authorized, the designer shall provide tree plantings as part of the contract. If a project requires any tree removal, every effort will be made to plant two new trees. Where right-of-way is too narrow to support tree plantings or underground and overhead utilities interfere with potential tree plantings, the designer shall review and consider an off-site temporary planting easement area adjacent to the street improvement. The property owner agreeing to this temporary planting easement shall be advised they will be responsible for the well being of the tree. Condemnation shall not be used to secure temporary planting easements.

The designer shall consult with the Supervisor of Street, Trees, and Public Grounds on location, species, and size of trees to be included in the contract. Spacing of trees should, where possible, be at 75-foot spacing, staggered on both sides of the street. Trees will be planted in medians where the width is 14 feet or greater and at a spacing of 75 feet centered within the median.

All tree planting locations shall be approved by the Traffic Engineer to ensure they do not interfere with sight distance of motorists or of any traffic control devices.

Street tree plantings on streets being constructed under the City subdivision regulations shall conform to applicable sections of the subdivision regulations.

